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CONTENTS

EDITORIAL:
Electromagnetic Induction 453
The Movement of Particles of Matter by the Electric Current 454
Electric Haulage on Canals 455
Electric Haulage of Canal Boats 456
Electric Driving at the Motherwell Iron and Steel Works 458
Illuminating Engineering Society 459
National Conference on Standard Electrical Rules 460
Gas Engines for Steel Foundry 460
The Electrical Show Company 460
Financial Reports of Electric Companies 460
New York City Subway Relief Plan 461
The St. Louis Buyers' Club Building 461
American Institute of Electrical Engineers 461
The Faraday Society 462
BOOK REVIEWS 462
Navigation of the Air 463
A New Design of Maximum-Demand Indicator 463
The Sawmills of Messrs. J & W. Bellhouse 464
The American National Red Cross 465
Rubber Industry in Peru and the Federated Malay States 466
National Electric Light Association 467
Electrical Developments in South Africa 467
Electrical Supplies for the Navy Department 467
Electric Signaling in the Simplon Tunnel 468
Pittsburg Section, American Institute of Electrical Engineers 469
Underwriters' National Electric Association 469
Telephone Train Despatching, by Edmund J. Burke 470
The Lake County Electric Power Company 471
Proposition for the Reorganization of the Whitney Company 471
New England Section of the Illuminating Engineering Society 471
Nebraska Electrical Show Postponed 471
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 472
INDUSTRIAL SECTION:
The Diehl Manufacturing Company 474
A New Gould Storage Battery Installation 476
A New Electric Glue-Pot 476
Bliss Trimming and Squaring Shear Geared to Allis-Chalmers Type "K" Motor 476
Canadian Crocker-Wheeler Company, Limited 477
Electrical Driving at the Montana-Tonopah Mill 477
Merchants' Association Election 477
New Principles in Street-Lighting, by Albert J. Marshall 478
To Protect Westinghouse Company 479
Receiver for Ohio Traction Company 479
CURRENT ELECTRICAL NEWS 480
RECORD OF ELECTRICAL PATENTS 485

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ELECTROMAGNETIC INDUCTION.

Our ideas of the mechanism of electromagnetic induction have always seemed very artificial and not altogether satisfactory. We have two statements of this effect: that due to Faraday, which says that when a conductor cuts a magnetic field an electromotive force is set up, and that given by Maxwell, which states that if the number of lines of magnetic induction which pass through a conducting circuit be changed an electromotive force will be set up. These might at first seem to amount to the same thing, but neither of them at first thought seems to explain all the effects of induction. For example, the second statement hardly seems to account for the action of the so-called homopolar dynamo, a type of machine which is the direct descendant of Faraday's disc dynamo, the action of which is more or less satisfactorily accounted for by his statement of the law; while, on the other hand, the action of a transformer is most satisfactorily explained by Maxwell's statement of the law.

At a recent meeting of the Philadelphia section of the American Institute of Electrical Engineers, Mr. Carl Hering described an experiment which he thinks makes clear the defects of the law as stated by Maxwell. This experiment consists in completing a closed circuit through two metallic springs which can be passed over the ends of a magnet and then drawn across the material of the magnet so as to pass the latter out of the circuit again without opening it. As the springs were passed over the poles of the magnet, an induction effect was set up as usual, but as they were drawn across the magnet so as to exclude it from the circuit, there was no such effect; and although the greatest care was taken in the experiment, making it clear that the circuit was not opened at all, not the slightest electromotive force could be detected. This experiment seems to Mr. Hering to emphasize the defect of Maxwell's method of stating the law and the advantage of that form in which it was given by Faraday. He holds that the law should state clearly that it is necessary that the material of the conductor shall be moved in the magnetic flux as the mere shifting of the circuit itself through a fixed conductor will not give rise to an electromotive force. On the other hand, Mr. Hering points out, in the case of the Hall effect, it is the path of the current that is shifted by the magnetic field and not the conductor.

These effects are not difficult to explain if one accepts the electron theory of metallic induction. If the flow of current along a conductor be due to the actual movement of the elec-

trons, then it is easy to see that there must be relative motion of these electrons with respect to the magnetic field for an electromotive force to be set up. Moving a conductor through a magnetic field, of course, moves its electrons with it and the forces thus set up upon the electrons tend to drive them in a direction at right angles to the motion and to the direction of the field. This is what takes place when the springs are slipped over the pole of his magnet. On the other hand, as one pulls the springs across his magnet, the springs themselves are not in a field, and, therefore, ineffective, while the magnet itself completes the conducting path between the springs and there is no movement of its electrons with respect to the magnetic flux. Hence there is no electromotive force set up. As regards the Hall effect, the action is similar. Here we have a current flowing which is nothing more than a procession of electrons, and if the conductor be placed in a magnetic field, these electrons, as they flow along the conductor and, therefore, through the magnetic field, will give rise to forces tending to drive them to one side. The effects are, therefore, not difficult to understand, provided, of course, the electron theory be accepted, and it is rather interesting to note, as pointed out by Sir Oliver Lodge, during a recent lecture, that we must always have the three components, representing the three directions of space; we have the direction of the magnetic force, the direction of the electric force and the direction of mechanical force or motion. These are the uniting forces of the universe and they seem to point to the foundation of three-dimensional space.

But accepting Faraday's statement of the law of induction does not make it easy to understand the action of a transformer. If it be necessary that the flux should actually cut across the conductor, one must assume, in a transformer, that this flux starts from the primary coil and spreads out as a leakage flux until it coincides with the magnetic circuit, and then collapses in the same way. But when it is remembered that the reluctance of the leakage path may be hundreds of times greater than that of the magnetic path, it is a little hard to accept this idea as what actually takes place. Moreover, according to Weber's theory of the magnetization of iron, by far the greater part of the magnetic flux is due to the twisting around of the molecular magnets, bringing them into the line, and if this be the case then the magnetic flux would seem rather to grow up in the iron itself than to be driven into it sideways by the exciting coil. Our magnetic theory recognizes two factors of the flux; that due to the coil itself, which is designated by H, and that due to the aligning of the little magnets of iron, usually designated by I. The first component may be thought of as springing out of the primary coil like ripples from a pebble thrown into water, but the other, and far more important, part of the flux arises in the iron itself. Yet the electromotive force which is set up in the secondary of the transformer is due to the total flux. Here Faraday's statement of the law of induction seems as defective as Maxwell's statement when applied to the homopolar machine.

The fact is we have no altogether satisfactory conception of the mechanics of electromagnetic induction. We have found Faraday's idea of lines of force, resembling stretched rubber bands, so useful that we have come to depend upon it almost entirely. Indeed, from the way the expression is used by some writers, they seem to have lost sight of the fact that these lines have no actual existence and were used by Faraday merely to indicate a condition of stress. Now there is no reason why a closed line of stress can not be set up without having to start as an infinitely small circuit and grow to its final size. For example, a state of strain can be set up throughout a hoop by a force supplied at one point; or motion of a fluid in a closed circuit of pipes can be brought about without it being necessary to suppose that the force in the first case is transmitted diametrically across from one side of the hoop to the other, or that water in the second will leak out of the pipe at one point merely to seep back into it at another. It is a fact that the student of magnetism is considerably hampered by artificial and unsatisfactory notions of what actually takes place, and we are still using the old ideas suggested by Faraday because no one has since then presented one that was better.

THE MOVEMENT OF PARTICLES OF MATTER BY THE ELECTRIC CURRENT.

The transportation of matter during electrolysis takes place indirectly, for while a metal may leave one electrode and reappear at the other, it does not appear in the electrolyte in the metallic condition, but is there only in the form of a salt. Of course, during electrolysis solid matter may be deposited on one or the other electrode, but this action is not necessarily a direct effect to the current. On the other hand, very small particles of solid matter have been observed to behave as though they were forced along through the electrolyte by the current, as reversing the direction of the current reversed the direction in which these minute bodies drifted. There has been no satisfactory explanation of this effect, but it has been suggested that it might be due to some such action as that which causes a globule of mercury, when placed in sulphuric acid between electrodes, to move from one toward the other whenever a current passes. This action seems to be an indirect effect of the current and to be due directly to the difference in surface tension of the two sides of the mercury caused by the two gases which are liberated by the current as it enters and leaves the globule.

Now, another case of migration has been noticed, but in this instance it is the movement of metallic particles along a more or less solid conductor. A paper published in the *Philosophical Magazine* (London), February, which has been contributed by Messrs. C. E. Mendenhall and L. R. Ingersoll, describes the action of small particles of metal when placed upon a Nernst glower through which a current is being passed. Two cases were observed. If the glower were sufficiently hot to melt the particles of metal, the latter would flow along from one end to the other at a speed which seemed to be fixed for each metal, but varied for the different metals from a slow, almost imperceptible, creep to a fairly rapid motion. In the other case, when the temperature of the filament was not high

enough to melt the metallic particle, the latter would roll or slide from one end of the glower to the other. In this case, also, the speed of the motion varied for the different metals. The direction of motion, while fixed for one metal, differed for different metals, some of these moving with the current in the common acceptance of that expression, others moving in the opposite direction. In some cases the force acting upon the particle seemed to be small, in others it was great enough to plow up the surface of the glower. In each case the direction of motion always reversed with the reversal of the current.

A careful study of this phenomena failed to produce an entirely satisfactory explanation of the cause. It was found that the effect took place only on conductors resembling closely the Nernst glower. The action seems to be due to the current and not to the heat of the glower, for when the latter was heated by an alternating current there was no motion of the small particles until a small direct current was superposed upon the other, when the motion was again observed; and its direction depended upon the direction of flow of the direct current. Nor did surrounding the glower by a different gas, such as carbon-dioxide, or placing it in a partial vacuum, affect the result perceptibly. It was found that the oxids of the metal behaved in a similar way. But perhaps the most interesting fact which was brought out, and one the reason for which is not apparent, is that if the metals be arranged in order of their atomic weights, all of those heavier than yttrium or zirconium—the oxids of which form the principal constituents of the glower—move with the current; while those elements having atomic weights less than the two named move in the opposite direction. If the direction of the motion had been found to depend upon the valency of the metals, the result would have been less surprising, although still unexplained, but it is difficult to imagine what the atomic weight has to do with it, unless one imagine that the electrons, in their passage along the glower, tend to drag atoms along with them, and that this drag is most effective on those atoms of least weight. This would tend to move the lighter metals against the direction of current-flow, as the electrons are supposed to be negatively charged, and, therefore, against the current; and, also, this tendency to shift the lighter elements to one end would tend to displace the heavier ones in the opposite direction. That there is some movement in solid electrolytic conductors has been believed for some time, but what this is is not known. These interesting movements of particles foreign to the glower material seem pretty clear evidence of such action, although they do not by any means prove it. But they suggest a possible method of investigating this phenomena. As the authors suggest, the motion may be due to a secondary effect similar to that by which the movement of the drop of mercury through the sulphuric acid is explained, but there are other effects noticed which have some bearing on the subject. For example, it was found that if the glower were partially coated with a certain metal, that this coating retarded the movement of the particle consisting of the same metal, but apparently had no effect whatever upon particles of other metals. There was also an apparent diffusion observed with several of the metals, platinum being one of these. This seems to be characteristic of less oxidizable metals. The diffusion is indicated by a streak along the surface of the glower directed against the flow of current, that is to say, against the direction of the motion of the metallic particle, as those metals showing this effect were all heavier than yttrium and zirconium. When an alternating current was passed through the glower, this streak was noticed on both sides of the metallic particle.

These interesting phenomena were observed while the authors were studying another curious effect, apparently not electrical. This was the fact that small particles of a metal, when imbedded in a Nernst glower, could be cooled considerably below their melting points and still remain molten. The amount of under-cooling was sometimes 300 degrees below this point, and when solidification took place, it was very sudden and gave rise to a phenomenon similar to that of recalescence. A similar effect was noticed when these particles were melted upon a heated non-conducting surface such as clay.

ELECTRIC HAULAGE ON CANALS.

In view of the great public interest which attaches nowadays to the subject of the canalization of shallow rivers and the improvement of inland waterways, the paper presented to the American Institute of Electrical Engineers at its meeting last week in New York city, by Mr. Lewis B. Stillwell and Mr. H. St. Clair Putnam is of peculiar timeliness and significance. The authors have been able to establish some interesting figures as a result of the comparative performances of two systems of canal-boat haulage—namely, mining locomotives on narrow-gauge surface tracks, and a monorail system, employing adhesion tractors, applied to a section of the Lehigh Canal, near Mauch Chunk, Pa.

The authors find a mechanical efficiency in favor of the locomotive. Owing to the method of application of the load, the under-running wheels of the tractor grip the monorail, and the adhesion of the machine is therefore a function not only of its weight, but of the pull it exerts. The weight of the tractor is 10,000 pounds less than that of the locomotive. The entire weight of the latter is available for traction, while to exert the same draw-bar pull the lower wheels of the tractor must be pressed upward with greater force as the pull approaches a maximum, thereby increasing the track and rolling friction of the tractor. On the other hand, the smaller electrical losses of the single motor on the tractor as compared with the two motors on the locomotive give the former an advantage, and the absolute efficiency leaves little difference between the two systems.

For canal-boat haulage as it exists to-day, it is not easy to see wherein the profit lies in applying a more modern system of propulsion; for with the fluctuating traffic it would be hard to find a more economical system than the occasional mule for the occasional tow-boat. It is well to bear in mind, however, that with the canal in question being worked to its capacity, changes in the locks being assumed, and with the present size of tow-boats in use, the cost of transportation with the electrical system, including all the capital charges, works out at between four and five mills per ton-mile, and the electrification would pay handsomely. Quoting Mr. Stillwell, the grand average of freight transportation in the United States by the railroads is very close to four mills per ton-mile, without any capital charges, locomotive repairs being paid for out of operation. With larger barges and larger locks the results would be further improved.

Electric Haulage of Canal Boats.

At the 226th meeting of the American Institute of Electrical Engineers, held in New York city on March 13, Lewis B. Stillwell and H. St. Clair Putnam presented a paper entitled "Notes on Electric Haulage of Canal Boats." By the courtesy of W. A. Lathrop, president of the Lehigh Coal and Navigation Company, for whom the tests were made, the authors were permitted to present to the Institute such results of their investigation as were not purely local in their significance, and comprised data more or less applicable to the general problem of electric operation of canals. The notes were based upon the results of tests conducted by the authors during the autumn months of 1907 on a section of the Lehigh Canal near Mauch Chunk, Pa. The object of the tests was to determine:

(*a*) Pull required to propel canal boats at various speeds and with varying numbers of boats in tow.

(*b*) The relative merits, for the purpose contemplated, of locomotives supplied by trolley and operating upon a track of forty-two-inch gauge, and a monorail system.

(*c*) The best speed and length of tow as fixed by physical conditions.

(*d*) The power required to operate the canal between Coalport and Bristol.

(*e*) The equipment required for such operation.

The data included in the present paper present the conclusions called for under headings (*a*), (*b*) and (*c*) of the foregoing summary.

One section of the canal, 10,095 feet long, was equipped with the locomotive system, and another section, 10,555 feet long, was equipped with the monorail system. On the section equipped with the locomotive system two ordinary mining locomotives were used, each weighing, under testing conditions, 16,000 pounds without testing instruments, equipment and crew. Each locomotive is equipped with two direct-current motors of twenty-eight horse-power, operating on a 500-volt trolley circuit. The locomotive wheels are twenty-eight inches in diameter, with a gear ratio of sixty-nine to fifteen. The wheel base is forty-four inches. On the section equipped with the monorail system three traction machines were used. Two of these tractors were manufactured in this country and one was manufactured abroad. The electric equipment of each comprised one direct-current, forty-horse-power motor. The gear ratio is 5.78 to one, diameter of wheels twelve inches, and length of wheel base forty-two inches. The ratio of leverage on the lever wheels is 4.7 to one—that is to say, the lower wheels are pressed upward against the lower face of the rail with a force 4.7 times the drag on the tow line. The adhesion of the machine, therefore, is a function not only of its weight, but of the pull which it exerts. Each tractor weighs 6,450 pounds, and under test conditions, with instruments and crew, 7,350 pounds. Tractor No. 3 was manufactured in Paris, and equipped with one twenty-five-horse-power mining motor. The wheels are 11.25 inches in diameter, the gear ratio 3.4 to one and the wheel base forty-two inches. Tractor No. 3 being superior to tractors Nos. 1 and 2, and producing better results in operation, was used for making the calculations presented in the report.

The monorail is supported at a height of four feet above the ground by steel posts placed at intervals of eighteen feet. The Mauch Chunk installation is an ordinary ten-inch I-beam weighing seventy-five pounds to the yard. The monorail, with supports and braces complete, weighs 120 pounds per yard, and is erected along the canal outside the tow-path.

In each test the tow line was approximately 200 feet long. Four canal boats were loaded and used in all comparative tests made. In addition to the tests of the four special boats, the regular canal traffic was handled by the test machines on their respective sections during the months of October and November and a part of September. Complete tests were made from time to time as opportunity offered until it was thought that sufficient data had been collected. The velocity of the current of water flowing in each section of the canal was determined at the time the tests were made, but to obtain the average value for towing resistance, including the effect of this current, and also of track grade, all tests were made in both directions over each section of the canal. The average results were used in the calculations. The above table shows the average results obtained at the average towage speeds attained in the tests.

Boats.	Weight. Tons. (2,000 Lbs.)	Average Speed in Miles per Hour.	Effective Pull. Pounds.	Constant. ($CV^2T.$)
Four boats loaded	548	2.98	2,200	0.452
Two boats loaded	274	3.62	1,500	0.418
One boat loaded.....	137	4.00	1,000	0.456
Four boats empty.....	95	4.00	1,010	0.664
Two boats empty	47.5	4.20	560	0.668
One boat empty.....	23.8	5.00	400	0.673

In the majority of instances where two-boat tests were made the boats were equipped with the so-called Erie steering gear. With this gear the second boat is used as a rudder for the first boat, to which it is tightly lashed. The effect, so far as the resistance of the water is concerned, is a reduction of approximately eight per cent in the pull required, in addition to which saving the boats are kept in better alignment and are under better control. In the majority of four-boat tests the first two boats were equipped with the Erie steering gear, but this beneficial effect as regards reduction of pull required was apparently lost owing to the effect of the drag of the last two boats, which tended to alter the position of the first two with reference to the line of motion.

Compared with electric railway operation the rate of acceleration practicable of attainment in towing canal boats is low. Acceleration, however, is relatively unimportant, as the time of run is long compared with the time consumed in acceleration.

Comparisons were made of the mining locomotives and tractors at speeds and effective pulls as nearly identical as was found practicable. To meet these conditions the various machines tested required different operating energy, and as change in the energy affected the motor efficiency, the electric losses in the motors in all cases were subtracted from the kilowatt-input in determining the mechanical efficiency of the machines. The mechanical loss of the motors and gears in each case was charged against the respective machines. The tow-line pull in all cases was corrected to the effective pull in pounds in the direction of motion. The results of these tests are given in the following table:

EFFICIENCY OF TOWING MACHINES.

	Effective Pull. 1,000 Lbs. Per Cent.	Effective Pull. 2,000 Lbs. Per Cent.	Effective Pull. 3,000 Lbs. Per Cent.
Mining locomotive..	80	83.5	84.0
Tractor 1.....	68	73.3	74.8
Tractor 3.....	73	77.2	77.5

In running without load the machines preserve approximately the same relation as they do when operating under load conditions, although the relative magnitude of the values is changed. When developing large draw-bar pulls the mechanical losses in tractor No. 3 are fifty per cent in excess of those of the mining locomotive. Mechanical losses in tractor No. 1

exceed those of the mining locomotive by from seventy to eighty per cent. Under light-running conditions these excess losses are reduced to about seven per cent in the case of tractor No. 3. The running-light losses are in themselves relatively unimportant, as the amount of power required is small and the amount of idle running relatively very small. This characteristic, however, shows errors in design and workmanship, and they are also corroborated by the results of the heavy-load test, and are therefore important.

Under load conditions, especially as the draw-bar pull approaches the maximum of which the locomotive is capable, the latter machine theoretically should show a higher mechanical efficiency. This is due to the fact that when the mining locomotive utilizes its entire weight for traction, to obtain a similar draw-bar pull with the tractor the two driving wheels on top must have a pressure upon them equal to the weight of the mining locomotive. As the weight of the tractor is 10,000 pounds less than that of the mining locomotive, a pressure of at least 10,000 pounds must be exerted on the lower or pressure wheels. It is evident, therefore, that the track and rolling friction of the tractor must be greater than that of the mining locomotive by the amount of this excess pressure on the track.

In hauling canal boats by mules, the speeds attained vary from 1.25 to two miles per hour. When the current assists the speed exceeds these amounts, and when the tow is against the current the speed sometimes drops very low. Dynamometer tests were made, and it was determined that in starting a tow a team of good mules could exert momentarily a pull approximating 800 pounds. The pull required at two miles an hour, as determined by the tests in which the mining locomotives and tractors were used, is 250 pounds. At 1.75 miles an hour it is 190 pounds. At 1.5 miles it approximates 140 pounds.

The practicable limits of speed when towing is done with towing machines depends upon the ability to steer boats, the wash of the canal banks, the time required for locking and the tonnage capacity and length of tow.

The authors conclude that single boats, loaded or empty, can be operated satisfactorily on tangents at speeds exceeding five miles an hour; but, on the canal, for satisfactory working, five miles on hour is probably about the limit of average speed for such tows. Two-boat tows are handled satisfactorily at speeds of from 3.5 to four miles an hour. Four-boat tows, loaded, can be operated with a fair degree of success at speeds up to three miles an hour, except on very sharp convex curves. Four-boat tows, light, were found impracticable as tested. Possibly with improved steering gear the difficulties encountered might be overcome. It is thought, however, that no conceivable steering gear would make it possible to handle four-boat tows, light, in a heavy wind.

As far as saving of time in locking the boats is concerned, it is not thought that much gain will be made.

It was thought that possibly single-phase, alternating-current motors of the compensated type might be used, and the authors develop certain tabulations of the speeds recommended for tows varying from one to four boats, loaded and empty, assuming that direct-current series motors or single-phase, alternating-current motors be employed. The conclusions are based upon the observed facts as regards ability to steer the boats, the wash of the canal banks, the relative time required in locking and between locks, and the tonnage capacity of the canal as affected by the length of tow. The speeds recommended for direct-current and alternating-current motor equipment, respectively, differ by reason of the different speed characteristics of the motors of these respective types. The following table gives the average time required for four, two and one-boat tows to make the round trip from Coalport to Bristol, loaded, and return empty:

TIME IN TRANSIT OVER ENTIRE CANAL—106.2 MILES, WITH EXISTING LOCKS.

System of Operations. Number of Boats in Tow.	Direct Current.			Alternating Current.		
	Four Boats.	Two Boats.	One Boat.	Four Boats.	Two Boats.	One Boat.
Time locking, down	42.6	18.7	11.3	42.6	18.7	11 3
Time between locks, down	34.8	30.2	25.8	36.3	30.2	24.6
Time locking, up	42.6	18.7	11.3	42.6	18.7	11.3
Time between locks, up	25.8	22 5	19.4	24.9	20.6	17.1
Add 10% contingencies	14.2	8 9	7.2	14.6	8.8	6.7
Total in transit, round trip	160 0	99.0	75.0	161.0	97.0	71.0

Estimating the total efficiencies, kilowatt input at trolley, and speed, for the mining locomotive and tractor, the efficiencies and inputs, including all mechanical and electrical losses, it is noticed that there is comparatively little difference in the efficiencies of the two systems, notwithstanding the fact that the mechanical losses of the tractor exceed those of the mining locomotive. This is due to the fact that the electrical losses of the two small motors used on the mining locomotive exceed the electrical losses in the single large motor used on the tractor.

For the conditions existing on the Lehigh and Delaware canals, it is estimated that the efficiency of a system of electric power transmission and conversion supplying direct current to the motors will approximate seventy per cent from the bus-bars at the power-house to the motor terminals. If alternating-current motors are used the calculated corresponding efficiency is seventy-five per cent. Based upon these efficiencies, the traffic conditions as existing on these canals, the watt-hours required at the power-house per total ton-mile, and per ton-mile of freight handled, are given in the following table:

WATT-HOURS PER TON-MILE AT POWER-HOUSE.

(AVERAGE FREIGHT HAUL, 55.6 MILES.)

Ton—2,000 Pounds.	Direct Current.		Alternating Current.	
	Mining Locomotive.	Tractor.	Mining Locomotive.	Tractor.
Watt-hours per total ton-mile:				
Four-boat tows	24.6	24.8	22.6	23 0
Two-boat tows	30.9	32 5	32.5	33.8
One boat tows	42.8	45.3	48.3	50.2
Watt-hours per freight ton-mile:				
Four-boat tows	33.9	37.2	32.5	33.1
Two-boat tows	44.5	49 7	46.7	48.6
One-boat tows	61 5	69.0	69.5	72.2

It should be noted that the calculated power for canal transportation as set forth in this table applies only to the especial conditions imposed by the physical limitations of these particular canals, and by the speeds for loaded and light boats which have been selected as most suitable for their operation.

At the conclusion of the paper Mr. Stillwell explained a series of lantern slides which were thrown upon the screen, and which were available through the courtesy of Percy Thompson, president of the Adhesion Traction Company. These pictures illustrated the several types of tractors and mining locomotives employed, the monorail system and the surface track, and also showed some of the features of the actual work carried on during the tests.

The discussion on the paper was opened by H. St. John Clark, chief engineer of the New York & Long Island Traction Company. Mr. Clark enlarged on some of the economic features of the traction system, which, of course, were not brought out in the paper. The fact that on national and state canals the tow-path is

considered a public highway would seem to make it necessary to leave the path open for an occasional mule that might be required by any individual desiring transport. This being the case, the selection of a mechanical system of haulage narrowed down to that one which could be put in place and not preempt all of the space available.

Concerning the suggestions made by Mr. Stillwell, affecting the mechanical design of the tractors, Mr. Clark stated that improvements were being constantly made, and that as a result of the tests which had been carried out, such mechanical improvements would be made as would wipe out the difference in the efficiency of the two systems. However, it seemed to him that there were economic conditions, such as had already been referred to, which entirely outweighed the matter of efficiency.

Mr. Thompson stated that he was well satisfied with the showing which had been made by the tractors, and that there was little to be added to the report which had been made by Mr. Stillwell. In view of the increasing importance of the subject of national waterways it was opportune for engineers at this time to become acquainted with the possibilities of electric haulage on canals.

Richard Lamb took exception to the suggestions made by Mr. Clark and Mr. Thompson, that the efficiencies of the traction system were negligible factors. He felt certain that only that system which would absolutely show an economy over any other form of propulsion would be the one selected to carry out the ideas of the engineers. He explained that transportation on canals or other waterways would necessarily always be at very slow speeds, and stated that there was a limit to which the speed could be forced, owing to the tendency of the bow water to create a wave which would be forced up on the canal bank and cause considerable depreciation. Also, with the wide, flat bottoms used in canal boats there was a point somewhere about six miles an hour at which the volume of water passing under the boat would be so decreased that the floating object would practically become grounded.

Joseph Sachs suggested that now that automatic adhesion and traction had been secured with the traction system of canal haulage that we could go a step further and put the control of the traction and speed of the traction motor in the hands of the helmsman on the tow boat. It seemed to him that it would be practical to run a light cable from the tractor to the boat, so that all the manipulations could be made by one man stationed on the boat.

Dr. C. P. Steinmetz raised a question as to the economic features of canal transportation. It seemed to him that the cost of mule traffic would be very low, and he wished to know whether data had been compiled estimating the capital charges and the possibilities of mechanical propulsion. He could see where, unless there was a steady traffic, the investment involved in laying down a system of electric or any other form of mechanical propulsion would be so great that the earnings would not justify it. The occasional mule would seem to be the more profitable method of transporting the fluctuating and light traffic which is now available on our inland waterways. In other words, there would be times when the mechanical systems would be operating very inefficiently, if there were not a great deal of idle machinery.

In closing the discussion Mr. Stillwell stated that, in all probability, if a better opportunity were given for canal transportation, a very good traffic could be worked up. Of course, the limit of a canal would be facilities for locking the boats through. On the particular Delaware and Lehigh canals the conclusions were made on the presumption that locking facilities would be arranged for taking care of the maximum capacity of the canal. Assuming the canal was taking care of its maximum tonnage, including all charges on the capital cost and operation, freight could be transported in the present barges employed at the rate of four mills per ton-mile. This was a little better than was being done at present upon the average railroad systems of the country.

Electric Driving at the Motherwell Iron and Steel Works.

The Motherwell Iron and Steel Company, a well-known British firm, has recently added a fifteen-inch roll mill to its equipment. This mill is utilized for rolling sections and strips and is coupled directly to a 500-horse-power, three-phase motor, running at from 145 to 150 revolutions a minute. Between the motor and the mill is a twenty-eight-ton flywheel, nineteen feet six inches in diameter. The frequency is twenty-five cycles a second. By means of a slip regulator the speed can be reduced momentarily to 110 revolutions a minute, so as to allow the flywheel to give up its stored energy to the mill during the short periods of very heavy load. The motor has a bar-wound rotor and current is supplied at 2,000 volts. The weight of the rotor with its coupling is seven tons. This coupling consists of intermeshed jaws with flexible packing between to take up sudden shocks. The slip regulator is a liquid rheostat which increases its resistance automatically as the load on the motor increases. This tends to make the motor lag behind the stator magnetism in phase, which tendency allows the flywheel to give up its energy to the mills. The rheostat consists of a vessel containing a number of horizontal pipes, through which water is circulated to keep the liquid cool. Below these are large horizontal plates which can be lowered in the liquid to decrease the resistance between them and fixed electrodes at the bottom of the tank. As the liquid is heated it rises and is cooled by the pipes at the top, thus keeping up a continuous circulation. The moving plates are actuated by a handwheel for starting the motor, and they are also independently attached to a lever carried on the projecting spindle of a small brake motor. The other end of this lever carries counterbalance weights. To start the mill motor the plates are lowered by means of the handwheel after the main stator switch has been closed. After the plates have been lowered a certain distance the lever engages with the lever attached to the brake motor. In the stator circuit of the rolling-mill motor there is a small three-phase series transformer, the secondary circuits of which are connected to the stator winding of the brake motor. The rotor of the latter motor is an ordinary short-circuited rotor. As the current supplied to the rolling-mill motor increases, the potential across the primaries of this series transformer also increases, thus supplying sufficient current to the brake motor to start it. The speed at which it starts depends on the amount of extra load on the main motor, and as the brake motor turns it lifts the plates in the rheostat, increasing the resistance and slowing down the main motor. As the load diminishes, the reverse operation takes place, as then the brake motor no longer has sufficient torque to hold up the plates. They sink into the liquid and speed up the main motor and its flywheel. The mill has been in operation only for a short time, but apparently consumes forty kilowatts for each ton of iron rolled. Two smaller mills are also driven in the same way, controlled by a similar automatic rheostat.—*Electrical Engineering (London)*.

Illuminating Engineering Society.

A meeting of the New York section of the Illuminating Engineering Society was held in the Engineering Societies Building, New York, Thursday evening, March 12. The local secretary, P. S. Millar, announced that a change in the programme for the April meeting had been made. The paper to be presented by Dr. E. L. Nichols on "Daylight and Artificial Light" will be read at the May meeting of the section, and Arthur Williams has agreed to take charge and make all arrangements for the April meeting, which will be on the ninth of that month.

The paper of the evening was read by E. L. Elliott, the title being "The Relation of Illuminating Engineering to Architecture from the Engineer's Standpoint." Mr. Elliott outlined briefly his conception of the development of civilization, stating that a love for beauty had grown up with man's skill in utilizing nature's resources. In early times there was no regard for time or human suffering, and the great changes which are recorded throughout history have been mainly due to the efforts of the engineer. What we term "modern civilization" is characterized by its extreme complexity, which is largely the result of a vastly greater knowledge of natural phenomena. This has resulted in placing the human family on a vastly higher plane of intelligence and general happiness, and those who are disposed to cavil at the materialism of modern science may be admonished that it is due to the scientist and engineer, materialists though they may be, that every individual to-day is free to work out his own destiny. The total amount of artistic appreciation among the masses of people is incomparably greater now than in the palmiest days of Greece and Rome, and it is the scientist and engineer who have brought this about.

Ancient and modern civilization, said Mr. Elliott, have scarcely a single important element in common, and yet the modern architect seems to have but one anchorage in which he has implicit faith, and that is a veneration for antiquity. The simple truth is that modern civilization has not expressed itself in architecture, and were our civilization to be blotted out, the structures which would most adequately portray its habits of life and thought would be our engineering works.

Reduced to its lowest terms, the business of the engineer is to produce a given physical result with a minimum of material and labor. Emerson has defined beauty—taken, of course, in its physical or material sense—as "that which has no superfluous parts, which exactly fulfills its purpose." In following this definition the work of the engineer is beautiful to exactly the degree that it is efficiently done. Broadly speaking, the modern building is simply an aggregation of utilities, and the extent to which it fulfills the purpose for which it was intended determines the excellence of its design. Building to-day has become almost entirely an engineering problem; and for various problems, such as the heating or structural work or ventilation, specialists are called in; but the necessity for an illuminating specialist has only been recognized to a limited degree.

Accepting the formula which has been given for the general field of engineering, the following fundamental proposition is reached: It is the business of the illuminating engineer to produce a given or required result of illumination at the minimum outlay for the original installation and subsequent maintenance cost. This leaves one highly important question still to be settled, which is, who shall determine what the required illumination shall be?—a question which must be decided jointly or separately by the owner, the architect and the illuminating engineer. The first has met his responsibility when he sets forth the purposes of the building, so that the question must then be decided between the architect and the illuminating engineer, and between the two, the greater economy of thought and labor will be secured by placing the responsibility upon the latter. The architect has a sufficiently wide field for his labor in the legitimate work of unifying and harmonizing on the diversified elements that enter into a building without bothering his head about the details of these elements. The advent of the illuminating engineer should be hailed with delight and relief by the architect, who is thus enabled to turn over the problems of lighting the building to one competent to handle them.

The work of the illuminating engineer has necessitated pointing out faults of prevailing practice, a disagreeable task, but one which must be performed. In many cases the sins of the architect have been rather of omission than commission, but frequently the architect has dedicated his duties to the fixture manufacturer, whose sins have not infrequently been largely those of commission.

The principal point in the dispute between the illuminating engineer and the architect seems to be the question of jurisdiction. The architect will admit the authority of the illuminating engineer in regard to the purely physical and economical aspects of the position, but denies the latter's authority in matters pertaining to the æsthetic or decorative features. The engineer, on the other hand, contends that under this ruling the architect can practically overthrow the results of the former's labor. Illuminating engineering involves questions of decorative art, but there is no reason why the illuminating engineer should not make an efficient study of this side of his profession to become an adept in it.

In opening the discussion, Bassett Jones, Jr., said the question seemed to be: How far shall good taste dictate the treatment of problems? He would not accept Mr. Elliott's idea of the development of the artistic sense, but said that there were definite periods when there had been, as it were, "a birth of beauty," and that the high plane which had been reached by the Greeks was due to the fact that every Greek was an artist and a philosopher. Artists are made and not born. For no one can become an artist without devoting to it years of hard effort. The illuminating engineer must, therefore, learn what is good by the test of hard work, and he must be taught to love beauty for its own sake. One can not judge the æsthetic value of an object by its utility. Mr. Jones thought that Mr. Elliott had overlooked the work of the philosopher in breaking the way for the scientist; and regarding the lack of a modern architecture he said that the Greeks and Romans had said the last word on building construction.

A. J. Marshall said that the aims of the society, instead of being conversional, should be rather toward co-operation. Those interested in illuminating problems should be brought together, so that each may learn the aims of the other and assist him so far as possible.

W. H. Gardiner, Jr., thought that the engineer should not interfere with the phases of the work which are decided upon by the architect, and he should leave matters of test to the latter, himself sticking to the materialistic side of the problem. Artistic sense can not be reduced to dollars and cents. It is a matter of training and feeling. Mr. Gardiner said that the architect labors under a disadvantage as he is called upon to do a great deal of work which is not profitable, and for such work it is out of the question to call in experts.

Closing the discussion, Mr. Elliott said that philosophy could not be given the

credit for the development of modern civilization. Science has brought this about only after hard struggles, and is still fighting its way against much opposition. The Greek style of architecture is not suitable for modern buildings, and that a modern style has not grown up must be attributed to the fact that no genius has yet been born who has been able, or dared, to use the materials of modern building undisguised.

Norman McBeth then described an illumination calculator which he has devised for lightening the labor of computing lighting problems. This is based upon the slide-rule, arranged in circular form and containing a number of scales, enabling the effect of angle, height and distance to be read off directly.

The meeting was then adjourned.

National Conference on Standard Electrical Rules.

The National Conference on Standard Electrical Rules will be held on Friday, March 27, at 1 P. M., in the Edison Auditorium, 44 West Twenty-seventh street, New York city. This is the conference which takes place annually directly after the Underwriters' meeting, which will be held on March 25 and 26. This conference reviews the rules approved by the Underwriters' meeting, and considers the effect which these rules may have upon all interests. W. H. Blood, Jr., is president of the National Conference on Standard Electrical Rules.

Gas Engines for Steel Foundry.

During January the Duquesne Steel Foundry, which operates a large plant in the Pittsburg district, decided to adopt the gas power system to operate the works formerly driven by steam. The initial equipment will consist of a 400-horsepower (maximum) Westinghouse gas engine of the three-cylinder, vertical enclosed type, direct-connected to a 240-kilowatt generator which will serve the various motor drives around the plant. The plant will operate on natural gas, which is available in large quantities in the Pittsburg district for power as well as lighting.

The Electrical Show Company.

Arthur Williams has been elected president of the Electrical Show Company, Incorporated. Plans for the coming show in New York city are on very broad lines and a number of features will shortly be announced.

FINANCIAL REPORTS OF ELECTRIC COMPANIES.

LOUISVILLE RAILWAY COMPANY.

The annual report of the Louisville (Ky.) Railway Company shows gross earnings from carrying passengers within the city limits of $2,497,567. This shows a total of 50,000,000 fares collected, or nearly 150,000 fares per day.

The officers elected at the annual meeting on February 19 were: T. J. Minary, president; Alex P. Humphrey, vice-president and general counsel; Samuel G. Boyle, secretary-treasurer. The following directors were elected: Charles T. Ballard, Harry Bishop, Samuel Cassidy, Attilla Cox, A. H. Davis, Oscar Fenley, H. H. Littell, A. P. Humphrey, John Stites, T. J. Minary and J. B. Speed, there being no change either in the directorate or in the personnel of the officials.

The company has acquired a franchise for double-tracking Thirty-first and Twenty-ninth streets from High avenue to Bank street, and has entered into a contract with the Louisville & Northern Indiana Traction Company by which the cars of the latter are to be operated over the Louisville company's tracks from the Kentucky and Indiana bridge to the interurban station on Third avenue.

PACIFIC TELEPHONE AND TELEGRAPH COMPANY.

The annual report of the Pacific Telephone and Telegraph Company for the year ended December 31, 1907, shows an increase of $1,491,949 in gross earnings, equal to 19.3 per cent. The increase in new stations was 44,801. During the year the company increased its bonded indebtedness by $8,750,000. Out of this it reduced its floating debt by only $297,455 to $8,360,950, and established reserve accounts amounting to $1,065,901, showing a cash expenditure in plant, real estate and equipment of $7,386,644. For this expenditure the book value of the plant, real estate and materials was increased in the balance sheet to $36,690,538. The Pacific company's excess of current liabilities over current assets is $4,898,318. This large floating indebtedness was due to the expenditures required in the replacement of the equipment at San Francisco and the extension of the system to meet the demands along the whole Pacific Coast.

CENTRAL NEW YORK TELEPHONE COMPANY.

The Central New York Telephone Company reports a deficit for the fiscal year ended December 31, 1907, after payment of interest charges, of $150,777. This compares with a deficit in 1906 of $143,006. The gross earnings in 1907 were $821,210; expenses, $661,162, and interest charges, $310,825. The company had 26,129 stations at the close of the year, as compared with 28,120 at the end of 1906, a loss in the twelve months of 1,991. The company has a floating debt of $5,821,000.

THE NEW ORLEANS RAILWAY AND LIGHT COMPANY.

The annual report of the New Orleans Railway and Light Company for the twelve months ended December 31, 1907, shows a surplus for dividends of $745,276, against $798,275 in 1906. The total earnings for 1907 were $6,041,291, as against $5,773,190, and the total expenses were $3,270,397 for 1907, as against $3,074,015 in 1906. The interest, taxes and other charges were $2,025,618 in 1907, as against $1,900,900 in 1906. The preferred dividends amounted to $312,500, leaving a surplus of $432,776. After allowing for the full five per cent on the $10,000,000 preferred stock, the balance for the common is equal to 1.22 per cent on the $20,000,000 outstanding.

WESTERN TELEPHONE AND TELEGRAPH COMPANY.

The Western Telephone and Telegraph Company reports net earnings for the year ended December 31, 1908, of $2,559,919. The surplus, after dividends, was $7,862, against $99,670 in 1907. The interest amounted to $668,109, and the dividends to $1,456,305. The total net receipts were $2,124,414.

WESTERN UNION TELEGRAPH COMPANY.

The Western Union Telegraph Company has issued its preliminary estimated statement of earnings for the quarter ended March 31, 1908. The net revenue is given at $1,100,000; bond interest, $433,062; dividends, $1,230,000, making a deficit of $563,062, leaving a surplus of $13,514,018. The actual figures for the quarter ended December 31, 1907, are as follows: Net revenue, $803,942; bond interest, $433,062; dividends, $1,217,000; deficit, $846,120. This compares with a net revenue of $1,116,791 in 1906.

President Clowry has issued the following statement: "In the report for the quarter ended December 31, 1907, the hope was expressed that business would soon resume and earnings become normal, but the commercial depression continues throughout the country and the revenues

of the company show a large decrease over the same period last year. This decrease, however, is greatly offset by reduction of expenses in all branches of the service. Notwithstanding the fact that this is the least profitable part of the year, the estimated net revenue for the present quarter, after paying fixed charges and bond interest, amounts to $666,937. This amount is being used for payment of the indebtedness resulting from the recent extraordinary expenses, which it will practically complete."

WESTERN ELECTRIC COMPANY.

The annual report of the Western Electric Company for the year ended November 30 last shows net earnings on 1907 sales of $1,217,000. Against this dividends of eight per cent, or $1,200,000, were paid, leaving a surplus balance of $17,000. On December 31, 1906, the indebtedness of the company was $27,082,552, including a contingent liability of $4,201,189 for bills receivable discounted. The business of the preceding year had taxed the resources and credit of the company. Sales had averaged nearly $6,000,000 per month. Although customers had maintained a good standard in remittance of payment of their accounts, the investment in accounts and bills receivable was $24,555,074. The process of reducing purchases of materials and pay-rolls began to be in full operation from February, 1907, and continued until about July, 1907. Since that time the rate of production in the factories has been in fair proportion to the volume of new orders. The success of the efforts in this direction is shown by the fact that the indebtedness has decreased $9,380,759, which, with an increase in cash of $1,147,425, comprises an improved financial condition to the extent of $10,528,184. Sales for 1907 were $52,724,168, as compared with $69,245,332 for the previous year, a decrease of 23.9 per cent. At the close of 1906 the capital and surplus were $35,102,000, a book value per share of $234.01. After deducting $1,338,000 of depreciation and extraordinary expenses in 1907, the book value of the stock on December 31 last figures out $225.21.

GALVESTON-HOUSTON ELECTRIC COMPANY.

The gross earnings for 1907 of the Galveston-Houston Electric Company were $1,050,893; net, $394,697. The latter figure was reduced by interest charges of $154,028; sinking fund, $31,661; dividend on preferred stock of the holding company, $34,742, leaving a surplus of $174,266. The gross earnings for 1906 were $906,487, showing an increase of $144,406.

The Galveston-Houston Electric Company is the holding corporation which controls the electric car systems of Houston and Galveston, Tex. The reports for the two subsidiary companies show the following figures: Houston Electric Company—45.5 miles of standard gauge track and 131 cars; paid six per cent on capital stock; gross earnings for 1907, $681,724; net, $247,052; interest charges, $100,037; sinking fund, $31,661; dividends, $60,000, leaving a surplus of $55,354. Galveston Electric Company—32.5 miles of standard gauge track; seventy-three cars; gross earnings for 1907, $369,168; net, $148,156; interest, $51,231; dividends, $21,000; surplus, $75,925.

RUTLAND RAILWAY, LIGHT AND POWER COMPANY.

The Rutland (Vt.) Railway, Light and Power Company's statement of earnings and expenses for the twelve months ended March 1, 1908, is as follows: Railway—Earnings, $105,561; expenses, $57,882. Gas—Earnings, $34,578; expenses, $22,187. Water, power and electric light—Earnings, $112,973; expenses, $63,153. Total, all departments—Earnings, $253,112; expenses, $143,162; net earnings, $109,950.

New York City Subway Relief Plan.

Bion J. Arnold, who has been making an expert survey of the New York city subway for the Public Service Commission, suggests, in his latest report, the double-decking of all express stations. It is asserted that this improvement would mean an increase of fifty per cent in the capacity of the subway. Mr. Arnold's proposal is that the local trains should stop on the upper deck, and that the express trains should use both tracks on the lower level. This would obviate, according to Mr. Arnold, the cumulative delays in rush hours. Even the fact that passengers would have to go up or down stairs in changing from local to express, or *vice versa,* would be of advantage, Mr. Arnold thinks, because it would tend to do away with the confusion that now exists at express stations during heavy travel.

Several observations of train movement with regard to the signal system are also made in Mr. Arnold's report.

The St. Louis Buyers' Club Building.

A new type of business building is under way in St. Louis, Mo., which will be designated as the Buyers' Club Building, promoted and financed by H. A. Vrooman, president of the State Trust Company, of St. Louis. The Buyers' Club Building will occupy an entire block within one block of the St. Louis Union Station. The ground area will be 234 feet by 524 feet, and the building will be eighteen stories high, with a tower extending ten stories above the building. The building will be given up entirely to the display of merchandise, with the exception of the top floor, which is to be furnished for club purposes exclusively for visiting buyers, convention delegates, etc. The tower will contain the offices. The club floor will comprise a convention hall, with committee rooms, the use of which will be given free, together with all the club privileges, to visiting buyers, and to conventions where the delegates are in a position to buy goods or influence purchasers. The first floor will be devoted to general display, administration and advertising purposes. The basement will be devoted to demonstrating machinery, engines, tools, etc., with provision for power of every nature. Sixteen floors will be used exclusively for sample rooms.

As a feature, the Buyers' Club plans to pay the fare of 10,000 buyers each year, the exhibitors to choose the buyers. Special trains will be hired to run from distant points where dealers from a wide radius can be gathered.

American Institute of Electrical Engineers.

The American Institute of Electrical Engineers' committee, empowered to select a location for the next annual convention, announces that the convention will be held at Atlantic City, N. J., with headquarters at the Hotel Traymore. The convention will begin on June 29, and is expected to close on July 2.

The board of directors announces the following nominees selected for the coming annual election: President, L. A. Ferguson, Chicago, Ill. Vice-presidents: Cummings C. Chesney, Pittsfield, Mass.; Calvert Townley, New Haven, Ct.; Bancroft Gherardi, New York city. Managers: D. B. Rushmore, Schenectady, N. Y.; H. E. Clifford, Boston, Mass.; W. G. Carlton, New York city; C. A. Stone, Schenectady, N. Y. Treasurer: G. A. Hamilton, New York city. Secretary: Ralph W. Pope, New York city.

The Faraday Society.

The thirty-third ordinary meeting of the Faraday Society was held on Tuesday, February 25, at the Institution of Electrical Engineers, London, England, Dr. T. M. Lowry presiding.

Dr. V. H. Veley read a paper on "Hydrolysis as Illustrated by Heats of Neutralization."

In this paper it is pointed out that a correlation of hydrolysis values, and basic constants deduced therefrom, with those of heats of neutralization presents interesting and important issues. As regards the former, determinations at different temperatures by equally accurate methods are wanted to test the validity of the Nernst equation $Q = RT^2 \epsilon \frac{d \log^{10} K}{dt}$; as regards the latter, no data are available in many cases.

Relationships of a general character are discussed for the hydrochlorides of nitrogen containing bases, and certain sodium salts of phenols and carboxylic acid. The effect on thermoneutrality and basic-constants by the introduction of a second amino grouping is considered, and it is shown that if attached to nitrogen it produces an increase, but a decrease if attached to carbon, hydrazin being an exception. Similar arguments are adduced as to the effect of the substitution in the benzenoid amines by various elements and groupings, and it is shown generally that the order of strength of such derivatives is $p > m > o$ in the majority of cases. The great increase in thermoneutrality and basic constants (almost complete disappearance of hydrolysis) caused by the addition of hydrogen to pyridine and quinoline appears to point to a total difference of chemical structure.

Finally, it is pointed out that determinations are required of hydrolysis values at considerable dilution of certain metallic chlorides, as determinations are either completely wanting or, if obtained, are discordant, and a hope is expressed that the record, however imperfectly presented by the author, may lead to a further interest in the subject.

Dr. G. Senter thought there was some doubt as to the connection between hydrolysis and heats of neutralization—the greater the one the less the other—arrived at in the paper.

Dr. A. C. Cumming asked how the author got over the difficulty of impurities in the water working at such extreme dilutions.

Dr. V. H. Veley agreed that there were factors other than neutralization involving heat changes. By his method the effect of impurities was eliminated.

A paper by Dr. Joseph Knox, entitled "A Study of the Sulphur Anion and of Complex Sulphur Anions," was communicated by Dr. A. C. Cumming.

The solubility of HgS (red and black) in Na_2S, K_2S and BaS solutions has been determined, and has been found to depend on the formation of the complex anion HgS_2''. By its greater solubility in these solutions the black modification of HgS has been shown to be the unstable form. The temperature-coefficient of the solubility in Na_2S between twenty-five degrees and thirty-three degrees is small and negative. The effect of adding NaOH to the Na_2S is to increase greatly the solubility of HgS, owing to the diminished hydrolysis of Na_2S. In the presence of a large excess of NaOH the HgS dissolved becomes practically equivalent to the Na_2S, pointing to the formula Na_2HgS_2 for the complex. The formula has been confirmed by electromotive-force measurements and by an investigation of the complex by the method of Bodländer (*Zeitschr. f. Physik. Chemie,* 1902, 39, 307). The constant for the formation of the complex anion from the ions $Hg^{\cdot\cdot}$ and S'' is:

$$k = \frac{[HgS_2'']}{[Hg^{\cdot\cdot}][S'']^2} = 5.1 \times 10^{54}.$$

From a solution saturated with both Na_2S and HgS a crystalline double sulphide of sodium and mercury—2 NaS, 5 HgS, 3 H_2O—has been isolated and analyzed.

The solubility of HgS in Na_2S_2 solutions is about half that in the corresponding Na_2S solutions, and the same complex anion HgS_2'' probably dominates here, too.

From the study of the complex formation between HgS and Na_2S it is concluded that Na_2S in dilute solution is practically completely hydrolyzed into NaOH and NaHS, and this conclusion is confirmed by independent dilatometric experiments on the catalysis of the decomposition of diacetone-alcohol by dilute Na_2S solutions (*cf.* Küster, *Zeitschr. f. anorg. Chemie,* 1905, 43, 53).

With the aid of the various constants obtained in the investigation, the constitution of the more important sulphide solutions used analytically in sulphide precipitations has been determined, and the approximate concentrations of the S'' and other ions in such solutions are tabulated.

By measuring the electromotive force of the metals in solutions of Na_2S of known S''-ion concentration, the solubility products of HgS, Ag_2S, CuS and PbS have been determined:

$[Hg^{\cdot\cdot}][S''] = 2.8 \times 10^{-54}$; $[Ag^{\cdot}]^2[S''] = 3.9 \times 10^{-50}$; $[Cu^{\cdot\cdot}][S''] = 1.2 \times 10^{-42}$; $[Pb^{\cdot\cdot}][S''] = 2.6 \times 10^{-15}$.

Dr. F. Mollwo Perkin referred to the bearing of the paper on analytical problems.

Dr. G. Senter asked whether the author in his experiments had reached equilibrium in both directions.

Dr. A. C. Cumming, in reply, said that Dr. Knox had done so in some cases.

Sir Oliver Lodge will deliver his presidential address to the society on Tuesday, March 24. The subject of the address will be "Some Aspects of the Work of Lord Kelvin."

BOOK REVIEWS.

"Stationary Steam Engines." William H. Fowler. Manchester, England. Scientific Publishing Company. Cloth. 300 pages. Illustrated. 8 by 10 inches. Price, 12*s.* 6*d.*

This text-book is based upon a series of articles published in the *Mechanical Engineer,* of London, which have been revised and collated for greater convenience in reference. The method of treatment is largely descriptive. The general design of different types of engines is considered, the details carefully studied, and the effects of variations in design upon the performance of the engine are explained. The types of engines described are largely of English manufacture, although some American engines are discussed. In the concluding part of the book accessory devices, such as condensers, cooling towers, injectors, etc., are briefly taken up.

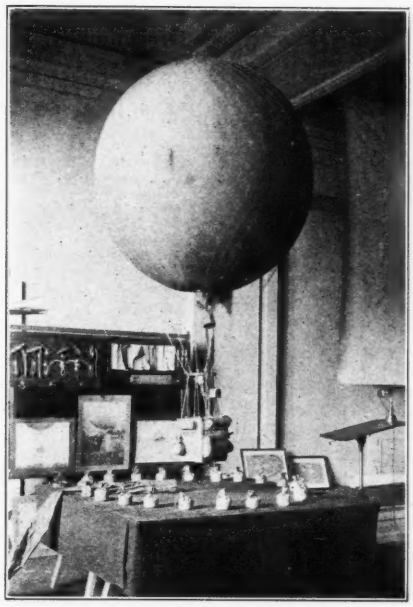
"Electric Wiring and Fitting for Plumbers and Gasfitters." Sydney F. Walker. New York. D. Van Nostrand Company. Cloth. 160 pages. Illustrated. 5 by 7½ inches. Price, $2.

This book has been prepared with the idea of bringing together a large amount of practical information on wiring of buildings, which will enable skilled workmen, such as plumbers and gasfitters, to carry out their work. An introductory chapter explains the various terms necessary and gives a little bit of theory, just enough to enable the workman to understand the reasons for the methods adopted. The author then discusses the insulation of wires, methods of splicing, methods of laying wires and cables, the installation of arc and incandescent lamps, types of fixtures employed, and the installation of switches, fuses and other similar appliances. The book treats the matter from the standpoint of English practice. It would be better for the American workman if the use of interior conduits had been given more attention at the expense of methods used abroad but not so much in this country.

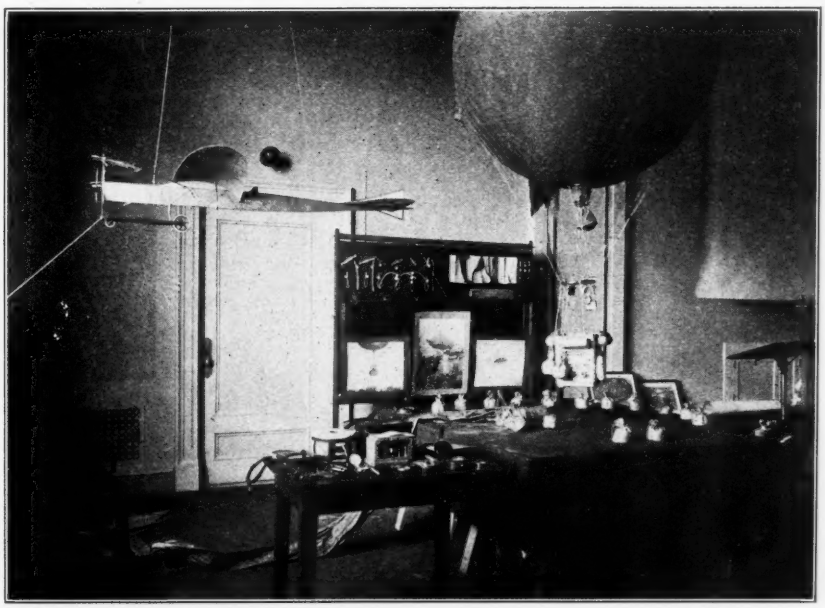
Navigation of the Air.

One of the most interesting meetings recently held by the New York Electrical Society was that of February 28, when Augustus H. Post lectured on "Navigating the Air." Mr. Post divided his subject into classifications, describing in detail the various forms of balloons and air-ships. The first part of the lecture was devoted to balloons, captive and free. The second part referred to dirigible air-ships heavier than air and lighter than air. The third part was devoted to a description of light motors for navigating dirigible machines.

During the lecture many illustrations were thrown upon the screen and moving pictures shown of flights by some of the successful aeronauts and engineers who are devoting a great deal of their time to the solution of the problem of navigating the air. A captive balloon was inflated, showing the method of taking on and eliminating ballast under certain conditions. The accompanying illustrations give a good idea of the interesting auxiliaries which were used to lend interest to the discussion.



Inflating a Captive Balloon at the New York Electrical Society Meeting.



Balloon and Heavier than Air Model Flying Machine, Exhibited at Meeting of the New York Electrical Society.

At this meeting the following members were elected:

Bernard H. Bueffel, J. W. Strippel, John H. Schaefer, H. H. Barnes, Jr., Raymond E. S. Haff, Samuel R. Barton, Daniel W. May, Matthew W. Ingraham, C. O. Rawalt, Herbert A. Emmons, Loring N. Farnum, Roscoe B. Holmes, William J. Andrews, John Gulbrandson, F. S. Norman, Herman J. Strobel, Dr. H. Taylor Cronk, Daniel F. MacDonald, C. H. Helvey, Clifford R. Beardsley, Arthur F. Muller, William F. Lee, Fred. E. Murphy, H. W. Rowley, Wm. G. Conklin, Harry T. Griswold, Percy Low Cobb, E. C. Alden, O. H. Tresselt and Frank C. Rose.

A New Design of Maximum-Demand Indicator.

The well-known Wright thermal maximum-demand indicator or some other similar device has come into wide use in Great Britain, but this device is not very suitable for large power installations on account of the waste of power in the indicator shunt. To meet this situation an indicator has been devised by Merz, which depends upon the principle of allowing the motor meter which is measuring the consumption of the installation to turn for a certain definite period a counting train. At the end of this period the meter is disconnected from the gear through which the counting train has been turned, and the former is reset to its initial position. The meter is then reconnected and the process repeated over and over again with the same time interval. The counting train acts as a non-return hand, and its indication shows the maximum consumption which has taken place during the resetting period. The chief difficulty with this form of indicator has been to carry it out mechanically. The method finally adopted is described by H. S. Hatfield in the *Electrician*, London, for February 28. Frequently on large power installations a number of meters are installed to indicate the consumption; two, perhaps, belonging to the supply and two to the consumer. If these are fitted with Merz demand indicators, it is necessary, in order that all should indicate the same, that the resetting of each indicator should occur at the same moment. It was primarily to meet this requirement, which can not be attained by the employment of an ordinary hand-wound clock in each meter, that the modified type was designed, but this new design has been found so superior to the old that it is being used in place of the latter. In this device the motor drives a recording gear so as to give it a certain ratio to the revolutions of the meter spindle. The worm through which the motor drives turns a wheel against the power of a hair spring, tending to restore it to its zero position, where it rests against a stop. Periodically this worm is lifted from the wheel by an electromagnet which pulls up a plunger working in a dashpot. At this moment the wheel returns to its zero position, while the plunger returns to its initial position at a rate controlled by the dashpot, which is made sufficiently long to let the released wheel become steady after the slight rebound which may take place. This wheel drives through gears a counting train to which are attached hands driven through friction, but which do not return to zero when the driving wheel is released by the magnet. These wheels then indicate the maximum demand which has been made during that period of operation when it was greatest. The action of the electromagnets is controlled by a spring-driven, electrically wound clock, the winding taking place at definite periods. When two or more meters are installed in the same plant, all the electromagnets are controlled by one clock.

THE SAWMILLS OF MESSRS. J. & W. BELLHOUSE.

AN INTERESTING INSTALLATION OF ALTERNATING-CURRENT MACHINES AT MANCHESTER, ENGLAND.

The sawmills and timber-sheds of Messrs. J. & W. Bellhouse, Miles Platting, Manchester, England, form an interesting example of the modern application of electric motors to the driving of wood-working machinery. The sawmills are situated on the banks of the Bridgewater Canal, and were established in 1792, so that the firm can claim to be one of the oldest in the trade.

Up to July of last year it had depended for motive power on a steam engine and lines of overhead shafting, with belts therefrom to the various machines. During the past few years the firm has been fully convinced of the many advantages to be gained by the adoption of electricity as the motive power, but owing to the capital represented by its steam-power plant, it was reluctant to make the change over.

In July of 1907 a disastrous fire burned the mills to the ground and the steam plant was destroyed. Recognizing, as it had done for some time, the advantages of the electric drive, it at once provided that the new sheds should have a complete electrical installation. The result is a thoroughly up-to-date equipment, with all machines individually driven by electric motors, and the whole factory electrically lighted. The plan of driving each machine by its own motor has advantages over the more common method of "group driving," the chief of which is perhaps the economical use of power and flexibility.

Messrs. Bellhouse's mills consist of two sheds or buildings, one of which is the joiner's shop (containing no machinery), the other building containing the sawmill and joiner's machine shop, the former section being merely a shed open at the sides, the latter being entirely enclosed.

In comparison with shops using steam engines and shafting for the driving of the saws and other timber-working machines, a marked improvement is effected by the absence of shafting from the walls. The abolition of long lines of shafting also means that there was no necessity of making the walls of such heavy and solid construction, thus effecting an economy in the building cost which amounted to a considerable sum.

The contract for the supply of the electric motors was placed with the British Westinghouse Company, all the motors installed being of its alternating-current, three-phase, squirrel-cage, induction type, except in one or two cases where motors of the Lancashire Dynamo and Motor Company's make were supplied with the machines. The total capacity of the motors installed exceeds 280 horse-power, the sizes ranging from one to fifty horse-power.

The squirrel-cage induction motor is essentially a constant-speed machine, so that in some cases where several speeds are required, the motor is connected to the machine through countershafts, with different-sized pulleys for obtaining the necessary range of speed. The motors are very simple, and in the case of the larger sizes are started by means of autostarters (one of which can be seen on the bracket to the right of the circular saw in Fig. 2), the handles of which are first moved to the starting position, when a reduced voltage is applied to the motor; on moving the handle from the starting to the running position (which is done as the motor attains a fair speed) the full voltage is applied to the motor, which will then run up to its full speed. In the case of motors below five horse-power, an ordinary knife-switch is frequently all that is necessary for starting, the motors being thrown straight on to the line.

The high-tension feeders of the Manchester Corporation are brought into the private substation, which contains two 250-kilowatt Westinghouse three-phase reducing transformers and a Ferranti three-panel, enameled slate switchboard. The transformer reduces the voltage to 420, at which pressure the motors are operated, and the switchboard contains the neces-

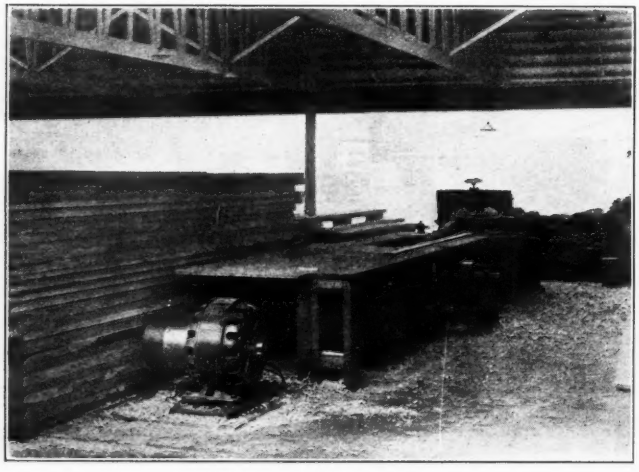


FIG. 1.—TWELVE-INCH BY FOUR-INCH, FOUR-CUTTER MOLDING MACHINE, DRIVEN BY TWENTY-HORSE-POWER INDUCTION MOTOR.

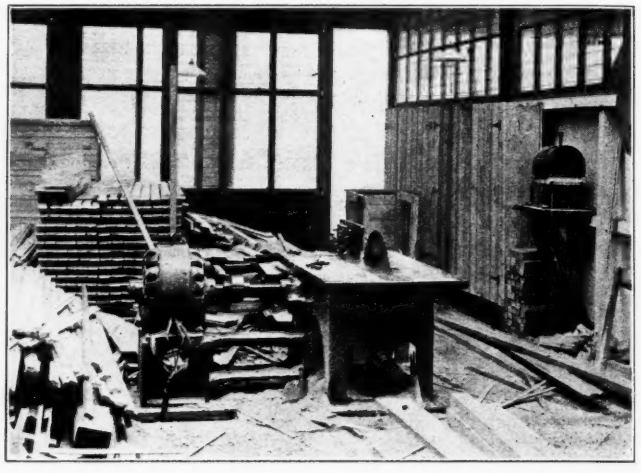


FIG. 2.—TEN-HORSE-POWER INDUCTION MOTOR DRIVING CIRCULAR SAW, BELLHOUSE SAWMILLS, MANCHESTER, ENGLAND.

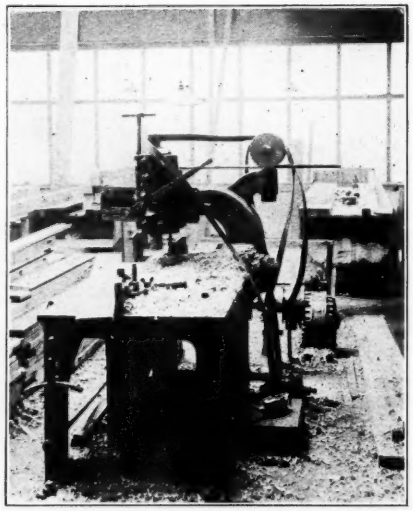


FIG. 3.—FIVE-HORSE-POWER INDUCTION MOTOR DRIVING SPINDLE-HOUSING MACHINE, BELLHOUSE SAWMILLS, MANCHESTER, ENGLAND.

sary switching and recording apparatus for controlling and recording the current supplied to the motors. A distributing switchboard is installed in the sawmill for recording the power consumption and for controlling the various sections of the plant.

The sawmill contains several large-sized woodworking machines, each driven by its own motor. A ten-horse-power motor drives a thirty-inch panel planer, and Fig. 1 shows a twenty-horse-power motor driving a twelve-inch-by-four-inch four-cutter molding machine. In addition to these there are several other large and important machines in the same shed, including a twelve-inch-by-five-inch four-cutter molding machine (thirty-five-horse-power motor), two self-feeding circular saws (thirty and thirty-five-horse-power motors respectively), twenty-four-inch-by-six-inch deal-thread machine operated by a fifteen-horse-power motor, a log band-saw machine driven by a Lancashire Dynamo and Motor Company's fifty-horse-power motor, the carriage being operated by one of the same company's seven-horse-power motors; a cross-cut saw (ten-horse-power motor), and a tool grinder operated by a two-horse-power motor.

One portion of the sawmill is partitioned off for saw sharpening and setting, and contains a circular-saw-sharpening machine and a band-saw-sharpening machine, each being driven by its own one-horse-power motor. The motors for the cross-cut saw, self-feeding circular saws, twelve-inch-by-five-inch molding machine and the deal-thread machine are all in the cellar beneath the shed, the belts being taken up through holes in the floor. This has the decided advantage of leaving the working floor comparatively free from obstructions.

The joiners' machine shop contains several smaller machines, comprising a circular saw driven by a ten-horse-power motor (Fig. 2); chain-mortising machines, driven by a seven-and-one-half-horse-power motor; jacker, dovetailing and automatic grinding machines, each with its own three-horse-power motor; spindle-housing machine driven by a motor of five horse-power (Fig. 3), and a tenoning machine driven by a ten-horse-power motor and illustrated in Fig. 4.

Occupying part of the space beneath the sawmill is an artificial drying chamber, heated by steam, piped from a large boiler at one end of the shops. For the purpose of rendering the temperature of the chamber slightly lower when it is necessary for men to work therein, a large fan driven by a four-horse-power motor is fitted into one of the walls. This fan reduces the temperature of the room in a very short time so that men can go and work there in comfort.

For the rapid and easy handling of the huge logs of timber which daily pass through the yard, and for the unloading of the timber barges on the Bridgewater Canal, a six-ton overhead traveling crane has been installed by Messrs. Craven Brothers, of Manchester, which runs along the side of the machine sheds and overhangs the canal. This crane is equipped with one two-horse-power and two ten-horse-power alternating-current squirrel-cage motors (Fig. 5).

The factory is busy at present with a large contract with Messrs. Craven & Markham for the Great Central Railway Company for the supply of all the woodwork for a large factory which the latter company is erecting at Dukinfield. In addition, the firm carries out work for builders and contractors, undertaking the manufacture of all wooden parts, such as window frames, doors, stairways, etc., and with the present up-to-date plant it is in a favorable position to undertake such work much more quickly and with far greater ease than before.

LIST OF MACHINES AND MOTORS.

Self-feeding circular saw....	30	horse-power
Self-feeding circular saw....	35	"
30-inch panel planer.....	10	"
12-inch x 4-inch four-cutter molding machine.....	20	"
12-inch x 5-inch four-cutter molding machine.....	35	"
24-inch x 6-inch deal-thread machine	15	"
Cross-cut saw.....	10	"
Tool grinder.....	2	"
Circular-saw-sharpening machine	1	"
Band-saw-sharpening machine	1	"
Circular saw.....	10	"
Chain-mortising machine....	7½	"
Jacker	3	"
Dovetailing machine.....	3	"
Automatic grinding machine.	3	"
Spindle-housing machine....	5	"
Tenoning machine.....	10	"
Fan	4	"
Long band-saw machine.....	50	"
Long band-saw machine (carriages)	7	"
Traveling crane (two).....	10	"
Traveling crane (one).....	2	"

The American National Red Cross.

The United States Government has decided to throw open the American National Red Cross to general membership. Under the plan every American citizen is eligible to membership. On application to Edward R. Johnstone, national registrar of the Red Cross, 341, War Department, Army and Navy Building, Washington, D. C., the applicant's name will be enrolled, a badge of membership forwarded, and the "Red Cross Bulletin" sent regularly for one year. Every candidate should forward $1 with application to cover enrolment fee and necessary expenses.

Information relative to the organizing of Red Cross circles will be forwarded by the national registrar on request.

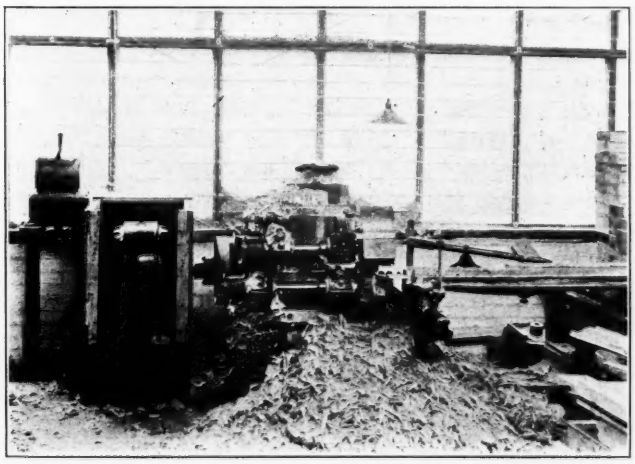


FIG. 4.—TENONING MACHINE DRIVEN BY A TEN-HORSE-POWER WESTINGHOUSE MOTOR. BELLHOUSE SAWMILLS, MANCHESTER. ENGLAND.

FIG. 5.—ELECTRIC CRANE FOR TRANSPORTING LUMBER, BELLHOUSE SAWMILLS, MANCHESTER, ENGLAND.

Rubber Industry in Peru and the Federated Malay States.

As a result of personal visits to various districts and camps within the sphere of his consulate, which embraces trans-Andean Peru, Consul Charles C. Eberhardt, of Iquitos, furnishes the following report covering the manner of securing the right to work rubber tracts, the manner in which the same are worked, and how the product is collected and prepared:

"Trans-Andean Peru would still be practically unheard of in the outside world were it not for the rubber industry. As nearly as I can gather, from conversing with leading lawyers and rubber men here, the laws of Peru covering the acquirement and working of rubber tracts are still incomplete and undergoing constant amendment. At present the following steps are held to be necessary:

"Selection of a tract of land is made and the location, description, etc., of the property advertised in the official organ for thirty days, that any claims against said property may be registered. At the expiration of this time, no countercharges having been made, the prefect of the department is petitioned, and he appoints a surveyor to lay out the land, furnish a plan of the entire tract, etc. This plan, together with the original description of the land, petition to the prefect, and all papers bearing upon the subject are forwarded to Lima for final action.

"If the procedures in the earlier stages have been regular in every particular, the request is rarely refused, though the difficulty of communication between Lima and the Department of Loreto at present requires that from six months to a year usually pass before final title is received, and this is only in the form of a lease for ten years, with the privilege of renewing at the expiration of that time, as the lands are not sold outright. No fixed cost can be given for such procedure, because it differs according to the difficulty of access to the tract for the surveyor, the bargain made by the petitioner with different parties employed, etc.

"The title for ten years having been secured, the petitioner may use the land as if it were his own, and his first movement is usually to place men at work locating rubber trees. One man will open up what is called an 'estrada,' consisting usually of as many rubber trees as can be visited and worked by a rubber gatherer in one day, the number of trees differing as the district may be thickly or thinly studded with such trees, the rapidity with which the rubber gatherer may work, etc. For instance, near Iquitos, many estradas contain but seventy-five or eighty trees, in the Javary River district the average is 150, while in the Acre district it is said that some estradas contain as many as 400 trees.

"For locating an estrada and clearing a path from tree to tree the workmen receive $25 to $37 United States currency. When this preparation has been completed, all is in readiness for the work of rubber gathering, which goes on during the dry season, from July to January, the trees being tapped in a fresh spot every other day during that time. Work can not be carried on during the entire year for several reasons: (1) By such constant tapping the tree would be worked to death in a short time; (2) during the rainy season a great portion of the land is absolutely impassable, because of inundation; (3) the rain water flowing into the cups and becoming mixed with the liquid renders it unfit for market.

"The rubber worker in the more thickly settled districts is usually a poor laborer, who buys his supply of provisions, consisting chiefly of rice and beans, from his 'padrone,' the owner or renter of the estradas, whom he must pay in rubber, at prices prevailing at the time of delivery. Charges for provisions are usually extremely high, and at the end of the season the laborer, though he may have delivered a large amount of rubber, is rarely out of debt to his 'padrone.'

"In a tract which I recently visited there were twenty-four estradas, worked every alternate day during the season by twelve rubber gatherers. I accompanied one of the men in his work, and performed part of all the duties of the rubber gatherers, from the cutting or tapping of the tree, placing the cups under the wounds, gathering the liquid, to finally smoking it over a half-smothered fire. Start was made at five o'clock in the morning, and the work of tapping the trees and placing the cups (each with a capacity of probably one-half pint), performed. The smallest trees (about six inches in diameter, none of smaller size being worked) carry two of these cups, the largest we visited (about two feet in diameter) carried nine, though the average was four or five cups on trees of from fifteen to eighteen inches in diameter. Much of this time we waded through the standing water of the swamps almost to our waists, and it was ten o'clock before we had visited all of the 150 trees.

"As soon as the entire round was made the milk-gathering was in order. Carrying a can of about two and one-half gallons capacity, we visited the same trees and emptied the cups, many of which contained less than a tablespoonful of liquid, and the entire day's work produced about two gallons. Returning to the hut in the afternoon this liquid was smoked over a half-smothered fire, being poured over a round stick, of about two inches in diameter, which is revolved in this cloud of smoke till the liquid is formed into a hard, white substance (which later turns black) of approximately two kilos (four and one-half pounds) of the best grade of rubber, or 'jebe fino,' worth at the present market prices about $10 United States currency.

"A new series of wounds is commenced every month at a point as high as the workman can conveniently reach, each subsequent wound being made a little below and in the same vein, till the bottom of the tree is reached at the end of the month. When a tree has been overworked and the milk does not flow freely, a scaffolding is constructed about the tree, which the worker mounts and inflicts the wounds farther up along the trunk. This practice, however, is very injurious to the tree, if not absolutely fatal in the end, and is forbidden on the tracts which I have visited.

"The foregoing are the methods ordinarily employed in Peru in working the 'jebe fino,' the best grade of rubber, and 'jebe debil,' the second grade. In the working of the 'caucho,' the cheapest grade of rubber, the tree itself is cut down and nature's work of years undone in a few moments. Thus it is that entire regions, vast in area, where the caucho was once to be found in abundance, are now entirely denuded of such trees, except for the young ones growing up, which will in time, of course, be far enough advanced in growth to be in turn productive, but it seems that natural recuperation can never keep pace with the present rate of destruction.

"In spite of the assertions of many of the 'Shiringeros' (rubber gatherers) that there is no cause for alarm at the increasing number of trees dying in proportion to the number of new ones springing up, and the further admitted fact that many of the trees which have worked for twenty and thirty years are still productive, there is no denying the fact that here in Peru at least the number of rubber-producing trees is steadily growing less. Systematic planting and cultivation would be of in-

estimable benefit to the country and the individual."

Consul Wilbur T. Gracey, of Tsingtau, China, transmits the following report regarding the cultivation of rubber in Perak, one of the Federated Malay States:

"At a recent meeting of the Perak Sugar Cultivation Company, held at Shanghai, considerable interest was aroused by a discussion of the best methods of cultivating rubber in Perak. The chairman of the committee, commenting on the conditions of cultivation, quoted from the magazine published by the Ceylon Agricultural Society, in August, 1907, as follows, referring to the tapping of rubber trees:

The greatest yield is recorded from Highlands and Lowlands estate, which reports an average from 38,639 trees of nearly two and one-half pounds per tree, while a yield of over seven pounds per tree was obtained from 807, widely planted to occupy sixteen acres. But such results are regarded as exceptional. It appears that these trees were nine years old.

"The chairman of the company above referred to states:

It can not be too strongly pointed out that too frequent or prolonged tapping is injurious and only produces inferior rubber. Even so recently as the Ceylon exhibition the discussion shows that the planters were quite satisfied with prospective rubber crops, as judged by the copious flow of latex, not appreciating the fact that it is the quality, or ratio of caoutchouc to latex, that alone constitutes the real crop and rich harvest.

"Letters were quoted from the manager of the Kalumpong estate, in which he stated in regard to the question of 'spiral tapping':

I have decided to give up this form of tapping. I am perfectly satisfied now that it is doing damage to the trees. It is much too severe for such young trees as ours, although it may be feasible to use it on trees from ten to twelve years old. All the planters who started it in the Federated Malay States have now given it up. I am getting excellent results with the herringbone system, and have decided to continue it, making six cuts on trees thirty inches in circumference and over and four cuts on trees under thirty inches. There is no doubt but that the trees require a rest, and as far as I can see this method of tapping one month and resting one month will give us the best results.

"It appears that the 807 trees on the Highlands and Lowlands estate, which gave at nine years old seven pounds per tree, occupied sixteen acres; that is, fifty trees to the acre, equal to 350 pounds of rubber to the acre. The trees on the Kalumpong estate have been planted twelve feet by twelve feet, giving 300 trees to the acre, which is admitted to be too close. These 300 trees, seven years old, gave one pound per tree, equaling 300 pounds of rubber per acre."

National Electric Light Association Convention Exhibit.

Final plans for the exhibition, in connection with the Chicago, Ill., convention, May 19-22, of the National Electric Light Association, were adopted at a meeting of the exhibition committee held on Thursday, March 5. Under the resolution adopted at the close of last year's convention, this committee is composed entirely of Class D members.

The exhibition will take place in the large hall on the top floor of the Auditorium Hotel, and the committee announces the engagement of the well-known Chicago architects, D. H. Burnham & Company, for the planning of the booths and decorations. Through the courtesy of the Electrical Trades Exposition Company, the railings, posts, cables and other material used at the recent Chicago Electrical Show will be utilized, but the general effect will be entirely original.

The plans provide for sixty-three booths, ranging in size from forty-four square feet to 123 square feet and, as heretofore, two or more sections may be combined into larger ones. Upon the whole, the area of the exhibition space is about the same as that of last year.

Perhaps the most interesting feature in the decorations will be the color scheme, to which much attention has been given. Appropriate to the times, the tungsten lamp will play an important part in the illumination of the hall. The object sought will be a uniform distribution of soft white light, rather than extreme brilliancy.

The convenience of members and their guests has not been overlooked. Adjacent to the elevators a large coatroom will be provided at which garments and packages may be checked. At the other end of the hall, near the passageway leading to the convention hall, will be located a counter at which convention papers may be left.

Judging from inquiries already received by the committee's secretary, the demand for space will be even greater than in former years.

Electrical Developments in South Africa.

The present power-development situation in South Africa is touched upon briefly in the *Electrical Engineer*, London, for February 28. It seems that the municipality of Johannesburg has had under consideration a plan for disposing of the electrical system to Beardmore & Company, who are to operate the plant and sell the bulk of the output to the corporation. The company is to be given the right to form two distinct companies, one for lighting and the other for power. The lighting company is to be provided with a minimum working capital of $1,250,000, and is to purchase the gas producers, gas engines and accessory equipment, the purchase price payable to the municipality being $875,000. Of this, $250,000 is to be paid in cash. The lighting company is to lease the property on which the plant is situated at a rate of four per cent on the capitalized value, and is to acquire five acres additional.

The company agrees also to furnish the municipality with a maximum of 10,000,000 kilowatt-hours a year, the latter guaranteeing to purchase a minimum of 9,000,000 kilowatt-hours a year for a period of ten years. The rate for this is to be two and one-half cents a kilowatt-hour, subject to certain modifications according to the load-factor.

A system of fines is provided for, similar to those under which the plant is now operated by D. Stewart & Company. Beyond this there is the provision that the council shall have the right to cancel the contract if the interruptions to the service aggregate two or three hours a month for the lighting, and less in the case of the railway supply. The company is to have the right of erecting another generating plant of improved type and supplying power to mines within the municipal area, but no other consumers. This plant, as well as the main plant, may be acquired by the council on arbitrary terms.

The second company, to be known as the power company, is to have a capital of $1,000,000. The exact functions of this company are not stated, but its object seems to be the erecting and equipping of a power station.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on March 24, for the following electrical supplies: 1,100 pairs lamp carbons, 500 incandescent lamps and miscellaneous electrical supplies for delivery at Washington, D. C. These supplies are all under Schedule 897.

Electric Signaling in the Simplon Tunnel.

It was found necessary, owing to the great length of single line from Brigue to Iselle (which includes the Simplon Tunnel) to divide this stretch into two block sections. Further, as, in accordance with traffic conditions, the trains follow each other at short intervals, a turn-out had to be provided in the middle of the tunnel. A signal station has, therefore, been built at this spot and is known as Tunnel Mitte. There the single line is provided with a turn-out, and there is also a signal box where the necessary signal and point levers are erected, and which is in both telegraphic and telephonic connection with Brigue and Iselle. The special conditions under which working in this tunnel is carried out prohibited the use of many of the ordinary signal fittings, *e. g.*, semaphore arms, though the apparatus installed is, in principle, not different from that ordinarily employed, and is arranged in a very similar manner to that on open-air sections. The following description of this system is taken from the *Electrician*, London:

The Simplon Tunnel is 12.4 miles long. From 5.5 miles to 5.9 miles is a turn-out, at the middle of which three rooms are formed in the tunnel body. One contains the necessary signal and block apparatus, together with telegraph and telephone equipment, another is an accumulator room, while the third forms a generating station for supplying the power required by both the signaling and lighting installations.

The signals consist of watertight lanterns which are lighted by a number of glow lamps. These are arranged in two groups behind glasses of different colors; one or other of these groups is lighted and gives the appropriate signal. The change-over from one group to the other is effected by levers in the signal box. These levers are interlocked with the point levers in the same way as are ordinary mechanically operated signals. There are in all ten signals, five of which apply to trains going from Brigue to Iselle and the remainder to trains going in the opposite direction. They consist in each case of a home signal with its distant signal, of a starting signal for each track and of an outer home signal. Each signal contains four lamps with the exception of the distant signal, which contains six. For this purpose, four-watt, sixteen-candle-power, metallized carbon-filament lamps are used. They are fitted with the ordinary bayonet holders and are connected in parallel. Two pilot lamps are provided in the signal box for each signal, except the outer home, and show in what position it is. There are, besides, ten ammeters, one on each signal circuit, which are calibrated in lamps and show at a glance how many lamps on that particular circuit are burning. Further, there are ten minimum current cutouts which, as soon as one or more lights are extinguished, cause a bell to ring. It will be seen from this that great precautions have been taken to prevent any false indication being given by an extinction of the lamps, and when the terrible consequences of a collision or derailment in the middle of so long a tunnel are considered, the wisdom of such a course is self-evident.

The track and signal switches are so arranged that when their circuits are broken—*i. e.*, when their indications or positions are changed—the minimum current cutouts are not affected, as their operation depends only on the total or partial extinction of the signal lamps.

In the signal box there are two levers for working and two levers for electrically interlocking the points, together with four signal levers. These last work in the following way: Two work each home signal and its appropriate distant signal, while the others work the starting and outer home signals. There are, besides, four rail contact levers, an electrical block apparatus in connection with similar apparatus at Brigue and Iselle, and a change-over switch, so that the apparatus can be worked by either continuous or alternating current. In the "on" position the track is set for straight-through working, while the track and signal lever are locked. One track lever sets the turn-out for trains coming from Brigue, the other for those coming from Iselle. The points are fitted with a controlling arrangement, which indicates by means of a bell when the signal levers are not correct for that particular position. For supplying the various apparatus and signal lamps, three-core rubber-insulated and armored cable is used. The interlocking arrangements between the points and signals usually employed at crossing-places are also used at this station.

One lever is provided for each of the home signals and its appropriate distant signal. One lever also works the two starting signals (one on each track) at the Brigue end, another lever working those at the Iselle end. Setting the home and starting signals for track No. 1 also places the outer home at "line clear," and it also returns to "danger" when the other signals are replaced. The levers of the home and starting signals are equipped with catches so that they can only be moved once ofter "line clear" has been given. The levers for the starting signals are also locked from Brigue or Iselle, and there is also connection with the electrical block apparatus.

In order to set a track for a given direction the track lever must be moved, and this can only be done when all the apparatus is in its appropriate position. The lever for the starting signal is first pulled off, and then the home signal for the track into which the train is to come is also set. In replacing the signal the operations are performed in the same order. Levers for one direction can only be worked when all the levers for the other direction are in the "off" position. The safety arrangements are very complete, and though it is possible for two trains to start in opposite directions from the two tracks, they can not start in the same direction.

When the signal apparatus was first designed, it was intended to work the trains through the tunnel by steam locomotives. As the consequent smoke might have obscured the signals, further warnings were supplied by automatic fog-signaling apparatus, which is placed out of action when the line is clear. These signals are operated electrically in connection with the signal lamps, and can be cut out of circuit by means of switches in the signal box.

Besides the various signal apparatus described above, there is a complete telephone system interconnecting the three stations Brigue, Tunnel Mitte and Iselle. On account of the high temperature in the tunnel, from thirty-five degrees centigrade to forty degrees centigrade, the central-battery system could only be used, and the same principle was employed which has been found to work satisfactorily on the Prussian-Hessian State Railways.

The apparatus is connected in series, and is constantly traversed by a control current, which, besides serving to show that the apparatus is in working order, also works the microphone. Any particular station is called up by means of a magneto, a dot-dash system similar to the Morse code being used. The magneto is on the direct-current system, so that it increases the constant current and sets a bell in operation. The apparatus such as the telephone, magneto, etc., are, with the exception of the bell, placed in cases of

Dutch metal, which are provided with lock and key. There are two receivers, which, when raised, cut out the bell circuit and switch in the speaking circuit in the usual way. A cypress-wood box covered with acid-proof varnish is also fitted to protect the apparatus from water drippings. The bell, which is quite watertight, has necessarily to be arranged on the outside of the box. In designing all the various apparatus great stress was laid on the fact that the parts should be easily interchangeable.

There are in all twenty-six telephone instruments between Brigue and Iselle. As under ordinary working conditions it is not necessary to speak over the whole of this distance, the system is divided into two parts by a switch at Tunnel Mitte station.

For signaling the trains large electric bells are used, and the necessary apparatus and relays in connection with them are fitted at Brigue, Iselle and Tunnel Mitte stations. This system is also divided into two parts by a switch at Tunnel Mitte. The bells are fitted in niches, which are about one kilometre apart, and are distinguished by lamps. On account of the acoustic effects the bell is fixed, not in the niche, but on the tunnel walls, while the necessary warning signal is given by the train working a switch on the line. In a corresponding way similar apparatus is also fitted at the stations and in the waiting huts.

For supplying the necessary currents for this apparatus accumulators are provided in the power stations at Brigue and Iselle, the whole system being also controlled from these points.

Pittsburg Section, American Institute of Electrical Engineers.

On March 4 the Pittsburg section of the American Institute of Electrical Engineers held its largest and most interesting meeting this year in the Carnegie Institute lecture hall. The meeting was unusually successful from a social standpoint, there being a great number of prominent engineers and other professional men present, making an audience of over 400. Just preceding the meeting a dinner was held at the University Club, sixty-five members being present, who represented some of the largest industries in this section.

C. E. Skinner, chairman of the section, introduced Ralph D. Mershon, the speaker of the evening, and called attention to the fact that Mr. Mershon was a former Pittsburger, and that he used to surprise his colleagues with his mathematical ability, one of his specialties being the binomial theorem, upon which he had written a very able essay. Mr. Mershon said that both he and the audience were gotten together under false pretenses. First, he was asked to give an informal talk before a few members of the society, and, second, there was no Zambesi-Johannesburg transmission and not likely to be any for several years. However, he had collected some pictures upon which he would talk.

While Mr. Mershon gave very little data in figures, he showed that he had considered thoroughly the business and labor conditions, which often count more in engineering than figures. The mineral wealth of the country has only commenced to show up, and nobody knows how great it is. The Victoria Falls Power Company is a company formed of British capital for the purpose of transmitting power from Victoria Falls (African Niagara), on the Zambesi River, to Johannesburg, a distance of about 700 miles, for use in mining gold. Mr. Mershon was retained by this company to make a report on the feasibility of such transmission, his being a report together with several European engineers. The European engineers reported favorably on the direct-current (Thury) system, while Mr. Mershon favors an alternating-current system, which will eventually be installed.

For the present Mr. Mershon has advised installing generating stations operated by steam, on the Rand, near Johannesburg, and by that means build up a market for electrical energy. At present the actual power used along the Rand is 85,000 horse-power, with the prospects that it will be largely increased in the near future. The idea is that after the mine owners become accustomed to the use of electric power and the market is assured, the transmission power plant and line can be built for conveying the power from the falls, and it will not be necessary to carry a heavy investment for a long time with only a partial earning capacity.

Kaffir labor is quite good, but ver peculiar. Laborers get two shillings a day and bosses one pound a day. Even at this, it is claimed that white labor is equally as cheap. General Botha, who had a great deal of Kaffir labor employed, gave Mr. Mershon full details of all troubles he would have to contend with.

Victoria Falls are on the Zambesi River at a point where the river is a mile wide, and there is an ideal location for a power-house and raceway where the river makes a sharp bend. The Rhodesian Railway (forming a portion of the so-called Cape-to-Cairo route) at present extends 400 miles north of the falls, and crosses the Zambesi River at the falls by a magnificent bridge 600 feet long and 400 feet above the river. The height of the fal is 400 feet, or two and one-half times as high as Niagara, and the spray rises to a height of 2,000 feet. It has been calculated that at least 300,000 horse-power can be developed by the falls at low water. The amount of water passing over the falls varies greatly at different seasons of the year. There is a deep gorge below the falls and a pool which is so deep that so far it has not been sounded. The pictures Mr. Mershon showed told a story in themselves which can not be described.

Underwriters' National Electric Association.

The sixteenth annual meeting of the electrical committee of the Underwriters' National Electric Association will be held on March 25 and March 26 at the rooms of the New York Board of Fire Underwriters, 32 Nassau street, New York city. The sessions will begin at 10 A. M. C. M. Goddard, secretary, has issued a bulletin containing the committee reports and suggestions for changes in the National Electrical Code, which will be considered at the meeting.

The committee reports refer to such matters as were brought to the attention of the committee at the last meeting, and which were considered of sufficient importance to require further consideration before action was taken. Special committees were therefore appointed to whom these various matters were referred, and by whom they have been considered during the past year. These reports will now be considered by the full committee and then brought before the general meeting in New York for final action.

The committee reports refer to mercury-vapor lamps, rheostats, transformers, wiring of electric cranes, rules 24A-c, 25d, 25f and 49A-b, recodification of National Electrical Code, circuit-breakers, variable-speed motors, outline lighting, street railways, switches and cutouts, Rule 13A, and reports from laboratories.

With regard to the suggested changes in rules and miscellaneous suggestions, it should be borne in mind that these have not had consideration as yet by the committee, but are simply a compilation of such suggestions as have been sent to the secretary to be brought up at the coming meeting. These changes will be carefully considered by the electrical committee at a preliminary meeting, and when brought before the general meeting, the recommendation of the electrical committee as to their adoption or rejection will be stated.

TELEPHONE TRAIN DESPATCHING.

BY EDMUND J. BURKE.

In the electric railway field, so far as high-speed interurban roads are concerned, one of the most important factors of efficient operation has been comparatively neglected, namely, the proper despatching of cars. No department of any business is properly managed unless, in every branch, the best methods and best appliances suited to that particular department are employed, and the same is true of the transportation department of railroads. Managers will spare no expense to have the best power-station apparatus, good track and roadbed, good cars, motors and tracks, advertise, make up time tables that give good service and at the same time are economical to operate, watch the nickels, and get the best trained employés that they can; but when it comes to despatching cars almost anything is good enough. This is not true in every case, for in comparatively few instances the managements have realized the importance of proper train despatching and have availed themselves of every rule, regulation and appliance calculated to bring it to the highest state of efficiency; but in the vast majority of cases one or more important details have been overlooked. It is the object of this article to point out the various points at which losses may and do occur and to show how they may be effectively stopped, or at least remedied.

For safe and efficient telephone despatching the first essential is a good metallic-circuit telephone line of no smaller than No. 10 bare galvanized iron wire properly strung. Wire smaller than No. 10 will be mechanically weak and from constant breaking and repairs will, in a short time, cost more than the heavier wire. The same argument applies to careful and proper stringing of the wire so as to keep it free from grounds of all kinds. Do not use twisted pair wire even where the line runs through trees. Twisted wire will cause much more trouble than plain bare wire. In such cases the trees should be trimmed so as to keep them from causing tree grounds, or the wire so supported on an insulator as to prevent its coming in contact with the tree. A badly strung, noisy telephone line may be the cause of orders being misunderstood, with the resultant accident and expensive damage to life and property.

Second, good, well-installed telephone switchboard and telephones. Cheap, poorly made apparatus will cost much for repairs, to say nothing of the more important waste of time of your despatcher and car crews in trying to use it and in being without the use of it. The despatching line should be used for despatching only, so as not to waste the time of car crews. Also, car barn and substation or power-station telephones not being cut out of circuit when not in use offer an excellent opportunity for damage and interruptions of service from lightning and other unavoidable electrical disturbances. Therefore, such telephones should be put on the general telephone service line and not on the despatcher's line.

Third, a competent despatcher employed in despatching only and so located as to be free from outside disturbance and interruption. A mistake on a despatcher's part may cost thousands of dollars; therefore, it is better to pay a little more and get a good, competent, reliable man and not distract his attention by giving him other duties to perform or allowing any one and every one to run in and out of his office.

Fourth, last, but by no means least, a good, well-designed, reliable despatcher's signal, entirely under control of the despatcher, and permitting him to selectively set a semaphore and red light at any desired telephone point on the line.

Such a signal permits the despatcher to get the fullest possible benefit and use from his telephones, saves his time, saves the time of the crews on the line and therefore saves the time of every passenger. It is generally customary when a car arrives at a turnout for the crew to wait a minute or two for the other car to show up and then report. Now, the other car may be very late and the despatcher may know it, but unless he has a signal he can not prevent that additional loss of time. With a signal, as soon as one car reports itself off schedule the despatcher can immediately set semaphores at various points and communicate his information and give new orders to all other crews interested without their having unnecessarily lost a second of time. Without a signal crews will not report promptly whereas with one they will, for the reason that when a signal is set it represents a definite order then and there from the despatcher. The above is only one of many ways in which time is frittered away, a minute here and a minute there, until the accumulations throughout the day amount to a lost trip. A lost trip means the loss not only of the money which that car and crew would have earned, but if each of six or eight cars loses a trip it means the expense of the additional crew and additional car, etc., to fill up the gaps caused by the lost trips of the six or eight cars. When all cars are on time and things are running smoothly according to regular time table, neither signals nor telephones need be nor are used. But when extra service is put on or work and line cars are on the road or the traffic has become deranged for some reason, the telephones and signals come into play and at such times the signals may earn as much as $300 or $400 in a day which without them could not have been earned and may, therefore, rightly be considered as lost. The above are not idle statements made for the sake of argument, but have been experienced over and over again in practical operation and can be proved by the testimony of some of the foremost interurban managers of the United States.

In addition to the above a despatcher's signal may be used to prevent accidents in each of the following ways:

All roads have certain sidings which are regular meeting points for the cars running on regular schedule. Now, if for any reason one car is delayed and the despatcher arranges a new meeting point he can at once also set a signal at that new meeting point and thus prevent the crew that arrives first at this new and unusual meeting point from forgetting and running by. The records will show that this is one of the most prolific causes of disastrous head-on collisions on electric roads. The writer can recall from memory nine accidents which have come to his attention in the last two years which cost the railroad companies concerned over $550,000, conservatively stated, in damage claims alone, to say nothing of the cost of damaged equipment and reputation, and reputation is something which can not lightly be considered even from a purely monetary standpoint.

Again if a despatcher makes a mistake and crosses his orders, with a signal he may correct it and save an accident; without a signal he is powerless. Experience and records will prove that added safeguards make employés more careful and cause them to better appreciate their responsibilities. This makes for better discipline.

Of the first three requirements above stated most managements now realize the importance, but of the fourth (the necessity for a despatcher's signal) there are very few who do.

This is only natural because the telephone and the running of electric circuits

are both now of considerable age, but a commercially practicable and reliable, selective despatcher's signal has not been on the market for more than three years. Therefore, railway managers have not generally had time to be educated up to it. Of nothing is the old adage that "What is worth doing at all is worth doing well" more absolutely true than the handling of trains or cars by the despatching method. When properly done it is by far the safest and surest method of getting traffic over the road; if improperly or carelessly done and without every available safeguard there is no more fruitful source of damage unless it be blindly and exclusively relying on automatic signals.

There is no better advertisement for a road than the fact that it handles its traffic safely and promptly, so that any money spent to attain this end gives better returns than any other form of advertising. Also a railroad that gets a reputation for availing itself of the best methods and appliances for the safe and prompt handling of its traffic gains both public and official good will and confidence which are as valuable an asset to a railroad as to any other line of business.

The Lake County Electric Power Company.

The following interesting information has been received from George P. Low, manager of the Lake County Electric Power Company, of Lakeport, Cal., a strictly local company, organized originally as the distributing company for Lake County, Cal., for the long-distance transmission service (prospective) of the Snow Mountain Power Company. When the last-named company determined not to extend its prospective transmission service into Lake County, the Lake County Company, having become organized, secured franchises, etc., determined to build a power plant of its own, using as the source of its proposed motive power natural gas, which had been known to exist in the county ever since the advent of white men. This determination occurred at the time when Mr. Low became identified with the company; in fact it was he who turned the energies of the company toward natural gas.

Lake County, colloquially termed "the walled-in county," forms a community that has been most backward in its development, yet which possesses wonderful fertility and all that; but despite the fact that some 50,000 health and pleasure seekers came into the county last summer, it is little known save as "the Switzerland of California." Its mineral springs are unequaled anywhere, yet it is distant twenty-four miles from the nearest railroad and its people are forty years behind the times. It has the telephone, but no telegraph or electric service of any other kind. Its natural-gas belt is best evidenced at Kelseyville, at the base of Mt. Konocti, where there is a so-called "gas mound," the antiquity of which goes back into Indian legendary. The first gas wells were bored there in 1876, as near as can be learned, but up to the present time the only use that has been made of the gas is to pipe it into two dozen or so houses in Kelseyville. Indeed, the fact that natural gas exists in Lake County is even now hardly known outside of the county.

The natural gas of Lake County is entirely different from that found elsewhere. It contains nothing but methane and carbon dioxide, with a trace of sulphureted hydrogen in the water that gushes up with the gas at Kelseyville. There is absolutely no free hydrogen, carbon monoxide or hydrocarbon gas (other than methane) to be found in the gas in question. Kelseyville gas from four different sources within a single three-acre tract possesses an average calorific value of 383 British thermal units per cubic foot, its specific gravity (with air) being 1.33.

It is natural gas of this character that the Lake County Electric Power Company will use in gas engines, and it is probable that the initial unit will be of 300 horsepower, direct connected to a 200-kilowatt, three-phase, sixty-cycle generator—the only doubt being as to the size of the initial unit. Preparatory to placing the order for the gas engine it is proposed to install one or more smaller units, say of twenty-five or thirty horse-power each, for the purpose of investigating the behavior of the gas, and particularly the compression necessary, for it has been impossible thus far to find a gas-engine builder who will undertake to give any guarantees with this particular gas without making a closer study of it in action than has yet been done. Especially is this true from the fact that competition for the business narrows down to only those gas-engine builders who make in sizes from 300 horse-power up, which will enable generators in direct connection to be run in synchronism with other alternators running at equal periodicity.

Proposition for the Reorganization of the Whitney Company.

A proposition providing for the reorganization of the Whitney Company, which is building water-power plants on the Yadkin River, in North Carolina, and is now in the hands of receivers, has been presented to the bondholders by Edward F. Buchanan, of A. O. Brown & Company. Mr. Buchanan states that A. O. Brown & Company have advanced in the neighborhood of $1,000,000 cash to the company, and that his company represents about half of the $5,000,000 Whitney Company bonds. The proposition provides for the formation of a new company with $5,000,000 seven per cent non-cumulative preferred stock, $5,000,000 common stock, $5,000,000 first-mortgage five per cent twenty-year bonds, and $5,000,000 six per cent second-mortgage sixty-year income bonds. The present bonds are to be surrendered for fifty per cent of their face value in income bonds, and a part of the preferred stock will be allotted to all bondholders participating in the agreement. A large part of the common stock is to be allotted to the present holders of the $10,000,000 Whitney Company stock. The first-mortgage bonds are to be issued to provide funds to complete the plant at not less than eighty per cent of their face value. All present bondholders subscribing for the first-mortgage bonds shall receive a bonus of fifty per cent in income bonds. The value of the plant in its present condition is about $2,000,000, and it would take at least $2,000,000 to complete it.

New England Section of the Illuminating Engineering Society.

The meetings of the New England section of the Illuminating Engineering Society have heretofore been held on the Tuesday following the second Friday of each month. This Tuesday is sometimes the second and sometimes the third Tuesday of the month. It has been thought best to definitely fix on either the second or the third Tuesday, in order that the members may always know the date in advance. The opinions of the members are now being secured with regard to the preferred date.

Nebraska Electrical Show Postponed.

The electrical show announced for the week of April 13, at the Auditorium, Omaha, Neb., has been postponed until the week beginning May 4.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Future of Copper.

By a study of the copper statistics for the past twenty-seven years, J. T. Marrow here predicts the probable production of copper for the next twenty years. He says that those who are closely associated with the economic side of any enterprise are prone to take too much to heart the periodical variations in the world's market, and in order to get a healthy and natural view of an industrial or economic condition, it is necessary to go far enough away from the field so as to bring the matter into proper focus. This he thinks is done by studying the increase of production at the time mentioned and by obtaining in this way average values for this increase. The production for the year 1879 was 170,310 short tons, for 1906 it was 788,609 short tons. The average increase in this time was 5.84 per cent a year. The increase during the last ten years was 6.4 per cent per annum. Assuming the lower figure as a basis for the rate of percentage increase for the next twenty years, he finds that by 1911 the production will be 1,047,409 short tons, by 1918 it will be 1,557,883 short tons, in 1923 it will exceed 2,000,000 short tons by more than 69,000 tons, and by 1928 the production will be 2,748,622 tons. The price of copper he believes will vary from time to time, owing to periodical market conditions. Knowing that the world is going to take copper in the future even faster than it has in the past, one may safely believe that it is going to pay for this copper, and of necessity at a price which will enable the producers to make a profit.—*Abstracted from the Engineering and Mining Journal (New York), February 29.*

Metal-Filament Lamps.

The use of tungsten lamps for street lighting is dealt with by Alton D. Adams, who points out that lamps of this type are now available for series circuits, and when thus used may effect a saving of about sixty-two per cent as compared with the ordinary three-and-one-half-watt carbon lamp, or by replacing thirty-candle-power carbon-filament lamps by sixty-candle-power tungsten lamps, double the amount of light is obtained, with a saving still of twenty-two per cent of the energy consumed. Fifty-candle-power carbon lamps may be replaced by an equal number of sixty-candle-power tungsten lamps, with a reduction in the required energy of fifty-three per cent. These lamps may be compared with mantle gas lamps using three and one-half feet of gas an hour, and giving sixty candles. A tungsten lamp of similar intensity will consume 324 kilowatt-hours a year. This will cost $19.44 if the electric service is rendered at the rate of six cents a kilowatt-hour for energy, care and renewals. The gas for the mantle gas lamp for 4,000 hours would amount to 14,000 cubic feet, costing, at $1 a thousand, $14, or $10.50 at seventy-five cents a thousand feet. Fixing the renewal of mantles for use, repair, lighting and extinguishing at three cents a lamp a night, this item comes to $10.95 a year, bringing the cost for the gas lamps up to $21.45 and $24.95 with gas at seventy-five cents and $1 a thousand respectively. Even allowing but two cents a night for care and maintenance, the gas lamp will cost at the lowest rate for gas, $17.80. The new lamp thus enables electric lighting to compare favorably on the score of cost with gas lighting. Comparing the tungsten lamp with a forty-watt enclosed alternating-current arc lamp, the latter placed 240 feet apart, gives, at 120 feet from the lamp, an illumination of 0.02 candle-foot. Placing sixty-candle-power tungsten lamps 104 feet apart, fifteen feet above the surface of the street, gives the same minimum intensity of illumination midway between them. Thus, with the same minimum illumination, 2.3 times as many tungsten lamps would be required as with enclosed arc lamps. These lamps will require only 186 watts as against the 400 watts of the arc lamps—a saving of fifty-four per cent. Five of the tungsten lamps might be placed on each 240 feet of street, and would take only the same amount of energy as the arc lamp. They would then be only forty-eight feet apart, and the minimum illumination would be 0.075 candle-foot—nearly four times that given by the arc lamps and affording more uniform illumination throughout. The manufacturers of the tungsten lamps promise to turn out a thirty-two-candle-power, forty-watt tungsten lamp which might be used instead of the present twenty-five-candle-power carbon filament consuming eighty-seven watts, thus effecting a saving of fifty per cent in energy and giving a much better illumination.—*Abstracted from the Municipal Journal and Engineer (New York), March.*

Electric Smelting of Pig Iron.

An analytical study of the electrical smelting of pig iron has been made by H. Allen, based upon the statistics which have been published by the Canadian commission which investigated this subject about two years ago, and upon various papers read before technical associations. When it is attempted to employ the heat energy of the electric current for producing pig iron from the raw ores, it must always be borne in mind that the reduction of the oxides can not be effected by heat alone, and a reducing agent must be provided to bring about the chemical reaction, for which purpose coke is usually employed. Smelting of a fairly pure ore in a blast furnace requires about nine-tenths to one pound of coke for each pound of pig iron produced. Of this from 0.34 to 0.48 pound of coke per pound of product is required for reducing purposes alone, and it is, therefore, evident that the margin in the substitution of electricity is confined to the reduction of the consumption of coke by from one-half to two-thirds of a pound per pound of pig iron. From the figures obtainable the author has compiled a table showing the composition and weight of materials charged into a furnace and the composition of the products leaving the furnace. He also computes the heat delivered to the furnace, that used in bringing about the reduction, and the various losses. The smelting of iron requires, first, the application of heat, and, second, the provision of reducing materials, and the new system has also shown that by carrying out both of these conditions concurrently in such an apparatus as a blast furnace, the most economical conditions, as regards the actual heat requirements, are not obtained. In the blast furnace the fuel is intimately mingled with the materials from which the resulting pig iron is to be produced, and any impurities contained in the fuel are taken up by the iron. If only the

actual amount of coke required for providing the reducing medium be charged into the furnace with the ore, and the heat conditions necessary provided by outside means, there would result both economy in regard to the quantity of heat and a purer product.—*Abstracted from the Mechanical Engineer (London), February 28.*

A High-Head Francis Turbine at the Centerville Power Plant, California.

Part of the old equipment at the Centerville plant, in California, which forms one station of the California Gas and Electric Corporation, has been replaced by a single large unit rated at 9,700 horsepower, operating under an effective head of 565 feet. This is the highest head under which a Francis turbine has yet been installed. The Centerville power plant is operated in parallel with ten other hydroelectric plants belonging to the company, as well as with three steam plants and one gas-engine plant. The aggregate rating of these plants is 133,000 horsepower, 93,000 of which is obtained from the water-power stations. The Centerville plant makes a second use of the water supplied to the De Sabla plant, which is taken mainly from Butte Creek, having a flow of 3,000 inches, supplemented by an additional 3,000 from the Hendricks ditch, which draws water from the west branch of the Feather River. After passing through the De Sabla plant the water is then taken out a quarter of a mile below and is carried eight and three-quarter miles by ditch and flume to Centerville. This diversion is secured through a concrete dam fifteen feet high and ninety feet long, which is arched upstream. The Centerville plant was started in December, 1902, the original installation consisting of one 900-kilowatt and two 400-kilowatt units, driven by impulse wheels operating under a static head of 575 feet. The new 5,500-kilowatt generator driven by the Francis turbine takes the place of the two 400-kilowatt units. This turbine was put into operation three months ago. It is of the radial, inward-flow, single-axial discharge type, with horizontal shaft. The total head of water under which it operates from normal head water to normal tail water is 591 feet. At full load, with 400 revolutions per minute, this is equivalent to an effective head of 565 feet. Owing to the limited output of the generator the wheel has never developed more than 8,200 horsepower, although rated at 9,700. The efficiency is eighty per cent at full gate opening, eighty-two per cent at three-quarter and seventy-seven per cent at half gate opening. The generator is a three-phase, sixty-cycle, 2,400-volt, 400-revolutions-per-minute machine, furnished by the Stanley-G. I. Electric Manufacturing Company. The revolving element is supported on a sixteen-inch shaft between two oil-ring bearings. Six 840-kilowatt and three 360-kilowatt, water-cooled transformers complete the main features of the installation. The high-tension lines are led away from the transformer room at 60,000 volts to a reinforced concrete fireproof switch-house, where open-air switches are provided for connecting to the De Sabla lines.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), February 20.*

Poor-Light Complaints—A Central Station Problem.

H. N. Muller discusses the method adopted by the Allegheny County Light Company, Pittsburg, Pa., for meeting the complaints of consumers about the quality of their lighting. These complaints usually fall into one of four classes: The consumer may have an exaggerated idea of the proper illuminating value of his units. He is apt to compare a sixteen-candle-power incandescent electric lamp with a forty or fifty-candle-power incandescent gas lamp. Often unfavorable location of the lamps and fixtures, or poor surroundings, will make the lighting arrangements ineffective. Sometimes the voltage of a system will be low, or the complaint is due to old and inefficient lamps. One very common fault found is the use of poor shades. These, the author says, might in many cases be called suppressors, as they are responsible for a large loss of light due to absorption, and when dirty they may cut it down fifty or seventy-five per cent. The fourth class of complaint, that due to old and inefficient lamps, is the one which is particularly considered here. From the information the company had been able to secure it became convinced that it was the condition of the incandescent lamps themselves that was responsible, and inspectors were sent around with instructions to replace two or three of the old lamps at various places by new ones, bringing the old ones in to the company's laboratory for inspection and test. The results were so striking that it became evident that such a haphazard method of collecting evidence would not do. The company had in mind the free installation of lamps, and for this reason found it necessary to obtain more satisfactory evidence that the outlay contemplated was justifiable. With this in view it was determined to institute a renewal of all the lamps beginning in the residence section and several plans were discussed, the one adopted being the following: A wagon was fitted with racks to enable it to carry about three thousand lamps—enough for one day's supply. This was sent out with inspectors, with instructions to take out all the lamps in each installation as they went along, replacing them with new lamps and bringing the old ones to the laboratory. Preparations were made there to handle the large quantities of lamps as they were brought in, so that those found in good condition could be picked out and used again. A certain number of new lamps were reserved for life tests so as to give a check on those which had been put out. The returned lamps were first inspected for blackening or defects; those apparently in good condition were then cleaned and again inspected, and the ones finally selected as being good were taken to the photometer and their candle-power and energy consumption were measured. Those that were found within five or seven per cent of the efficiency of new lamps and of the proper brilliancy were returned to the renewal department for reinstallation. The cost of this inspection, cleaning and testing was about five mills for each reclaimed lamp. With these old lamps and the addition of new ones, the work went on until the entire section had been refitted with good lamps. A great many minor details were involved in this work, such as standardizing the fixtures and repairing defective work, which in some cases amounted to a considerable item, but the expense was borne by the company in order to put the entire installation in the very best shape. In carrying out this reinstallation the company limited itself to sixteen and eight candle-power units, and adopted 108 as the standard voltage, as this would enable it to obtain an excellent selection of lamps. The cost of this change has not yet been fully determined, but using as a basis a lamp taking three and one-half watts per candle with an average economical life of 800 hours and consuming during this period of service forty-five kilowatt-hours, the renewal cost amounted to about four mills per kilowatt-hour. A three-and-one-tenth-watt lamp with an economical life of 530 hours gives a renewal cost of about six and one-half mills per kilowatt-hour. The actual cost will probably run a little above this, as the lamps are handled several times.—*Abstracted from the Electric Journal (Pittsburg), March.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The Diehl Manufacturing Company.

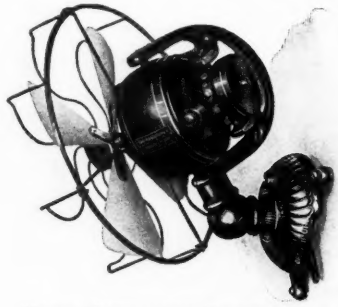
The Diehl Manufacturing Company, Elizabethport, N. J., is placing on the market for 1908 a full line of desk, bracket, trunnion and ceiling fans. The Diehl "Universal" fans represent the most advanced ideas in the development of fan motors, combining in one unit the desk, trunnion and bracket fans. They may be adjusted to propel the air in any direction, and do not require extra parts or special tools to adapt them to their various positions. The trunnion turns on a seat milled on the upper half of the ball, the movement being nearly a complete circle, and limited only by the screw, which acts as a stop. A spring acts as a brake and allows the fan to be set at any desired point. The pressure of the spring is great enough to prevent any movement due to the action of the motor or air currents set up by the blades, but it is so adjusted that the direction of the air current may be changed by turning the fan body with the hand.

The change from desk to bracket fan, or *vice versa,* is very readily made. A clamping screw passes through the centre of the two halves of the ball and serves to hold them together. In the lower half, which is attached to the base, three holes are drilled, one at the top and two at the sides, ninety degrees apart. In the upper half three holes are similarly placed, except that they are reversed, one being at the bottom and the others at the sides. When the two halves are brought together the pin in the upper half engages the hole in the lower half, and the clamping screw secures them in place. When the pin engages the hole at the side the fan is arranged for desk use; while if the top hole is engaged the bracket arrangement is obtained. As the pin projects only one-sixteenth of an inch, it is only necessary to loosen the clamping screw to that amount to allow the change to be made, the only tool necessary being a screw-driver. Malleable cast-iron is used for both parts of the ball, in order to eliminate any chance of breakage either in shipment or by accidental means.

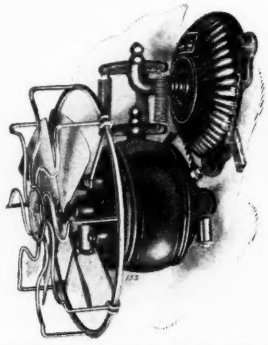
The speed regulator is so constructed as to be entirely fireproof and indestructible. The resistance is composed of wire specially made for this purpose, wound upon plates of pure selected mica. The switch base is of glazed porcelain, heavily ribbed, making it practically unbreakable. The connections from the resistance plates lead to four brass studs, which form the contacts and provides for three speeds of the fan and one blank for stopping.

The company has also developed a telephone booth fan, the adjustable features being replaced by suspension springs. Owing to the use for which these fans are

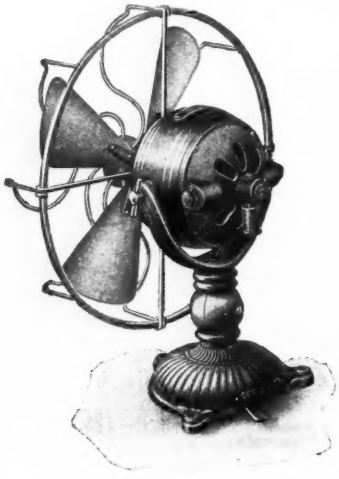
DIEHL OSCILLATOR DESK FAN.



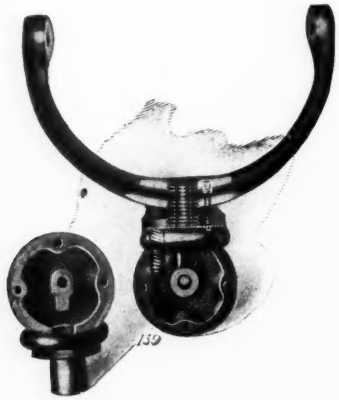
DIEHL OSCILLATOR BRACKET FAN.



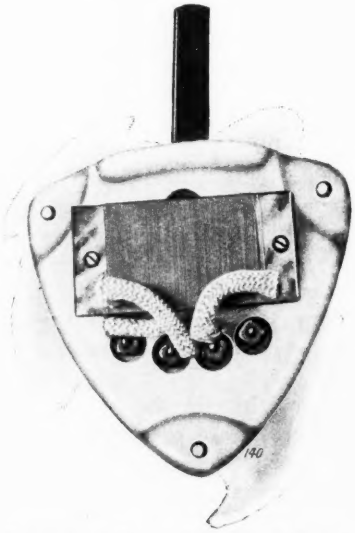
DIEHL TELEPHONE BOOTH FAN.



DIEHL DESK FAN.



DETAILS OF ADJUSTMENT, DIEHL FAN MOTOR.



DETAILS OF DIEHL FAN MOTOR SPEED REGULATOR.

intended it is necessary that they be absolutely noiseless and free from vibration.

The Diehl oscillator fan is provided with the split-ball feature similar to the arrangement of the "Universal" fan, and can, therefore, be adjusted in the same manner for desk or bracket use, as desired. When used as a bracket fan the angle is so fixed that the blades are in a plane about fifteen degrees from the vertical, and the air current is directed downward to that extent. It is noiseless in operation and requires a practically negligible amount of additional power. The oscillator fans are made in two sizes, with twelve and sixteen-inch blades, and are provided with regulators giving three speeds. The oscillating action is derived from the motor shaft, through differential gears, which are entirely enclosed in a suitable case filled with grease.

The "Universal" fans are made with nine-inch blades for 110 volts and 0.2 ampere; nine-inch blades for 230 volts and 0.12 ampere; twelve-inch blades for 110 volts, 0.4 ampere, and twelve-inch blades for 230 volts, 0.2 ampere; sixteen-inch blades for 110 volts, 0.75 ampere; sixteen-inch blades for 230 volts, 0.4 ampere; sixteen-inch blades for 550 volts, 0.2 ampere. The telephone booth fans are made with nine-inch blades for 110 volts, 0.12 ampere, and nine-inch blades, 230 volts, 0.7 ampere.

The Diehl ceiling fans are particularly attractive. The No. 44 fan is of the iron-clad type and is furnished with four blades carried by malleable-iron blade holders finished in polished nickel. The covers are ornamental castings, and the body is covered by a band finely finished in japan, beaded, and with gilt stripes. The stem is japanned without casting. This fan runs at 210 revolutions per minute. The No. 45 fan is of the same general construction as the No. 44. The working parts are easily accessible, and the armature may be removed without detaching the body from the ceiling. The switch tube is provided with cable with extra wires, and the switch-holder is drilled so that the No. 45 fan may readily be changed to an electrolier fan by adding light brackets and making connections. The fan is furnished with four special Nyssa wood blades, and runs at 210 revolutions per minute.

DIEHL STANDARD COLUMN FAN.

The No. 46 electrolier fan has the same features in construction as the Nos. 44 and 45. The light brackets are of sufficient length to give the lights proper angle and spread. The fan is furnished with four Nyssa wood blades, light brackets, key sockets and shade-holders for four lights. The fan may be furnished with two or three lights on special order. The lights have a spread of eighteen inches, and the fan runs at 210 revolutions per minute.

The Diehl standard two-blade ceiling fan No. 13 has gained rapidly in popularity since its introduction in 1889. The No. 16 electrolier fan is similar in design to No. 13, with special light brackets added. A special feature of the electrolier fan is the detachable basket, which may be unscrewed from the fan without disturbing any of the wire connections. Connection with the lights is made by means of a special screw coupling, one part of which is contained in the basket, which it serves to hold in place. It is furnished with key sockets, shade-holders and shades for five lights. Baskets may be furnished, however, for two, three or four lights on special order. The spread of lights with this electrolier is twenty inches.

The No. 17 fan is a very handsome apparatus, and is particularly suitable for surroundings of rich and artistic character. The trimmings are of spun brass ornamented with open cast brass work of elegant design, and in cold weather the blades may be removed and the device used as a lighting fixture. The fan is furnished with Nyssa wood blades, special shades, shade-holders and sockets for five lights. The basket may be furnished for two, three or four lights on special order. The No. 18 fan is similar to the No. 17, but without electrolier attachment.

The company also makes a column fan which is extensively used where it is im-

DIEHL NO. 45 CEILING FAN MOTOR.

DIEHL NO. 17 ELECTROLIER AND CEILING FAN MOTOR.

practicable to hang a ceiling fan. The base, which is rigidly screwed to the floor, is a solid casting finished to match the upper half of the standard, basket and corona. The lower half of the standard is marbleized. The upper part is a heavy brass tubing, and an iron pipe extends through the centre of both, insuring a rigid and substantial outfit. This fan is furnished with trimmings of the same design as those used on the No. 13 fan.

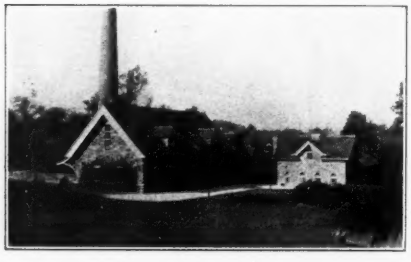
The electrolier column fan is of the same general construction as the column fan. The trimmings are the same as on the No. 16 electrolier, and the two circuits from the lights and fan extend to the base.

Blades on all ceiling fans Nos. 13 to 18 have a full sixty-inch sweep.

A New Gould Storage Battery Installation.

The Gould Storage Battery Company, 341 Fifth avenue, New York city, has been given a contract to install for William W. Harrison, of Glenside, Montgomery County, Pa., a large storage battery, consisting of sixty cells, type S-623, in lead-lined tanks. This battery will be placed in the present battery house on double-tier reinforced concrete racks. The capacity of this new battery is 220 amperes for eight hours.

Mr. Harrison's estate is said to be one



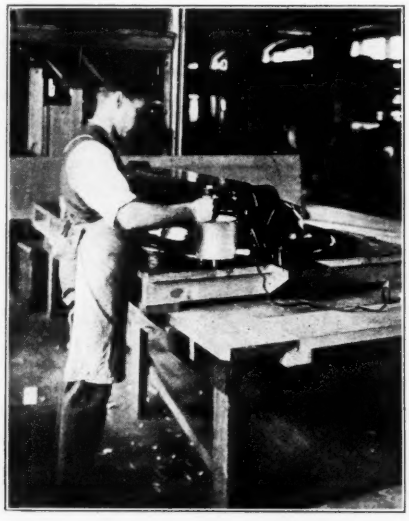
Battery House and Repair Shops, Harrison Estate, Glenside, Pa.

of the finest in the United States and the battery installation will be in keeping with the surroundings.

A battery about equal to this was installed a few years ago, which, with the new one, will make a total of 120 cells. The current from these batteries is used for not only lighting purposes, but also for power. Besides the light plant there is a machine shop, ice plant, in fact everything necessary to both repair and construct whatever may be needed.

A New Electric Glue-Pot.

The electric glue-pot recently placed on the market by the General Electric Company embodies an interesting feature of design in the elimination of the water-



General Electric Electrically Heated Glue-Pot in the Pattern Shop.

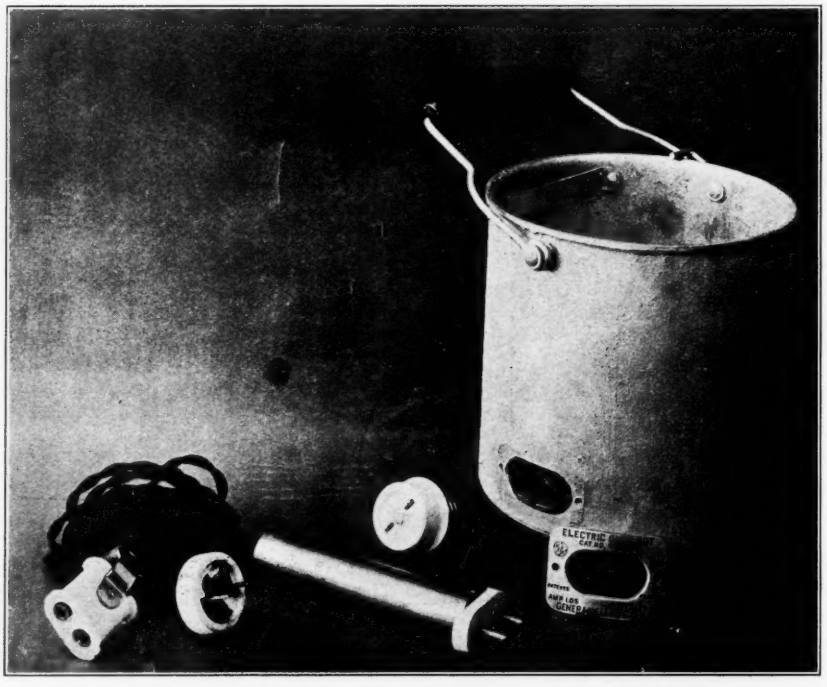
jacket, which is a necessary feature of the ordinary glue-pot, inasmuch as this water bath serves not only to distribute the heat evenly to all parts of the glue, but also prevents it from becoming overheated.

The elimination in the General Electric glue-pot of the water-jacket has been made possible by the adoption of a casting of pure aluminum which forms the glue-pot proper. The high conductivity for heat, together with proper design of heating unit and proportioning of radiating surface, combines to keep the glue at the proper temperature, although the maximum temperature of the exterior and bottom of the pot never exceeds 180 degrees Fahrenheit.

The heating element is of the well-known cartridge type and possesses the characteristic features of simplicity, renewability and long life. It is stated that by the omission of the water-jacket a saving in electricity of as much as fifty per cent in the smaller sizes has resulted. The practical efficiency of the General Electric glue-pot and its result-producing work render it particularly valuable to carpenters, pattern-makers, bookbinders, etc. To the central station manager it affords possibilities for building up a profitable day load, and should prove as successful in this respect as the more popular electric flat-iron.

Bliss Trimming and Squaring Shear Geared to Allis-Chalmers Type "K" Motor.

In the accompanying illustration is shown a machine especially adapted for



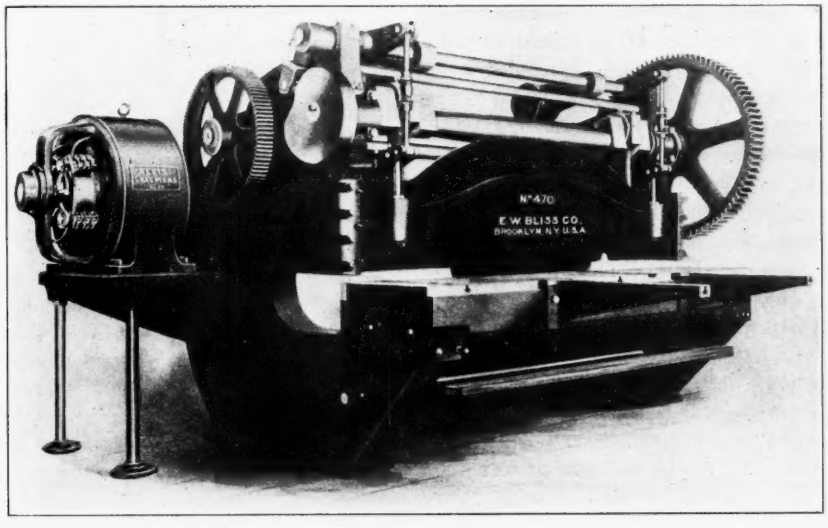
General Electric Self-Contained, Portable Glue-Pot Heater.

trimming and squaring sheet iron and steel in single sheets or in packs up to three-eighths of an inch in thickness and eleven feet four inches in length. The blades are each made of a single piece of

solid tool steel with two cutting edges, and are carefully hardened and ground.

An adjustable automatic cam-actuated clamping bar, directly in front of the upper blade, descends in advance of the latter, securely clamping and holding the pack until the cut is completed. It releases automatically as soon as the cut is made. The clamping device is operated from a cam on the end of the main shaft, which imparts motion to a rock shaft, across the top of the machine. Two levers on the rock shaft give motion to the clamping bar by means of two connections arranged with suitable adjusting screws to regulate the pressure upon the work.

There is an eighteen-inch gap in the housings, so that a plate or pack of greater length than the blades may be trimmed by moving it along and taking successive cuts, the gauges being so arranged that the continued cut will be straight and in line with the first; or a plate, or pack, thirty-six inches wide, may be sheared lengthwise through the middle.



ALLIS-CHALMERS TYPE "K" MOTOR GEARED TO BLISS TRIMMING AND SQUARING SHEAR.

The machine illustrated is driven by a forty-horse-power Allis-Chalmers type "K" motor, mounted on a platform attached to one side of the trimmer, and geared to the main shaft, making the apparatus one that requires little floor space and is easy to regulate. This motor, which is wound for 220 volts, or any standard pressure required, and runs at 750 revolutions per minute, has been especially designed to meet the requirements of machines such as that above described, the bearings and shafts being of liberal proportions and great stiffness.

The main shaft of the shear is of hammered steel, six and one-half inches in diameter, with the two cranks for operating the cutter bar forged and slotted out. The shearing and trimming blades are actuated through a five-foot gear, to which is attached a powerful automatic friction clutch controlled from a foot treadle. The crank shaft is at a standstill until the treadle is depressed, when it makes one revolution, performing its work, and stops with the cranks at the highest point. The driving shaft makes 150 revolutions per minute, with gearing in the ratio of 7½ to 1, giving twenty strokes per minute to the cutter bar. Length of cut, eleven feet four inches; width between housings, eight feet seven inches; depth of throat, eighteen inches.

Canadian Crocker-Wheeler Company, Limited.

Another promising sign of returning confidence in the business situation is the organization of the Canadian Crocker-Wheeler Company, Limited, for the manufacture and sale in Canada of the well and favorably known Crocker-Wheeler apparatus.

The latter company manufactures practically all types of direct-current and alternating-current motors and generators, power transformers, motor-generator sets, frequency changers, etc., some of the best-known lines being direct-current motors for special purposes, such as machine-tool and printing-press drive and steel-mill work. For the latter, a line of motors has been specially developed which has been found to fully meet the very severe conditions which exist in steel mills. Crocker-Wheeler alternating-current generators up to 2,000 kilowatts' capacity have been in successful operation in Canada for some years.

The officers of the company are as follows: Fritz E. Lovell, president; R. A. Stinson, vice-president; E. John Bell, secretary-treasurer.

The head office is located in the Street Railway Chambers, Place d'Armes Hill, Montreal.

Electrical Driving at the Montana-Tonopah Mill.

One of the most modern and skilfully designed crushing and concentrating plants is that of the Montana-Tonopah Mining Company, of Tonopah, Nev. The plant was designed by the Allis-Chalmers Company, Milwaukee, Wis., under the direction of F. L. Bosqui, consulting engineer for the mining company. The details have been so worked out that the entire plant was a success commercially, metallurgically and mechanically from the start.

The plant is arranged in separate buildings to conform to the contour of the country and also for protection against fire. The mill is driven throughout by electric motors, and these motors are distributed so as to give unit drives to the various departments. The sixty-cycle, three-phase, 440-volt current used is bought commercially, transformed down from 6,600 volts, and distributed from the main switchboard to the various motors located at the different points in separate buildings. The motors are of the Allis-Chalmers standard induction type, and this company furnished all the electrical equipment, including transformers, switchboards, etc.

Merchants' Association Election.

At the annual meeting of the Merchants' Association, of New York city, held on March 5, the following officers were elected: President, Henry R. Towne, president Yale & Towne Manufacturing Company; first vice-president, Gustav H. Schwab, Oelrichs & Company; second vice-president, William A. Marble, vice-president R. & G. Corset Company; third vice-president, W. Jay Schieffelin, Schieffelin & Company; treasurer, Gustav Vintschger, president Markt & Company, Limited; secretary, S. C. Mead.

By unanimous vote resolutions were adopted commending the long service of Clarence Whitman, the retiring president. Resolutions were also adopted advocating the creation of a non-partisan permanent tariff commission, for a commission providing for a system of land title registration, and for a committee devoted to increasing the scope of the School of Political Sciences of the George Washington University, Washington, D. C.

NEW PRINCIPLES IN STREET-LIGHTING.

BY ALBERT J. MARSHALL.

Great improvements have been made during the past few years in the artificial lighting of interiors; in fact, illuminating engineers have centred almost their entire attention on improvements in such installations. Consequently, street lighting has not received the time and study necessary to bring it up to a high point of efficiency.

While it is true that much experimental work has been done with a view of improving the general street-lighting conditions, yet this has not involved radical changes in methods. In some cases one type of an electric arc has been substituted

FIG. 1.—HOLOPHANE REFLECTOR.

for an arc of another type and make. Sometimes two or three arc lamps have been used instead of one or two. Possibly a new type of incandescent lamp of higher efficiency than the one previously in use was substituted, or more posts erected rather to carry out some ornamental effect than to better the actual lighting condition. Such methods of "improvement" seemingly have satisfied the public. Because a possibly greater amount of light was used (generally speaking, the amount or quantity of light even now used is much too little) it was taken for granted that better results were being obtained. But the makeshifts did not accomplish the desired results, because the spots of light on the street produced by a larger number of light sources were thereby simply increased, so that if we were looking up and down the street, instead of seeing the roadway equally or uniformly illuminated, our attention was at once called to a series of patches of light below the light sources. Furthermore, in cases of incandescent gas or electric installations where lamps were hung between nine and twelve feet from the ground, the eyes were also worried to a certain measure by the intrinsic brilliancy of these light sources.

It was with the idea of radically improving these conditions and of giving a correct distribution of light rays that the Holophane Company essayed to produce a globe or reflector which could be used in connection with the various artificial light sources out-of-doors. The following ends were sought: first, to do away with the bright patches of light and to distribute equally the light rays in desired directions; second, to so construct a globe or reflector that the maximum light rays would be thrown not only out toward the street, but up and down the street as well; third, to obtain this distribution by a globe or reflector which would not be affected, to any marked degree, by the elements; fourth, to protect the eye as far as possible from the high intrinsic brilliancy of our modern light sources without much loss by absorption; fifth, to obtain a globe or reflector for out-of-door use that would be tough and not easily broken, and would in turn protect the lamp as much as possible.

After much experimenting with various ideas, the Holophane Company developed and is now introducing such a street-lighting reflector, listed as No. 243 (Fig. 1), which is wonderfully successful in meeting all the foregoing requirements. It has two faces, or, more literally speaking, a face and a back. The face, or that portion which faces the street proper, has a smooth exterior with a series of vertical and refracting prisms on the interior. The back, or that portion which is toward the sidewalk, has a series of vertical totally reflecting prisms on the exterior and a smooth interior. As all prisms are vertical, they do not afford an easy resting-place for dust, and rain will, to a large measure, assist in keeping it clean.

The distribution given by this reflector both in horizontal and vertical planes is truly remarkable.

Fig. 2 represents the intensity observed in a plane taken ten degrees below the horizontal while the unit, consisting of a forty-candle-power clear Gem lamp and Holophane reflector No. 243, was revolved around its vertical axis. Attention is here called to the fact that inasmuch as all prisms on this reflector are vertical, several different types of lamps may therefore be used in connection with it, as the vertical position of the filament will not materially alter the distribution curve shown in Fig. 2. It will be noticed by referring to this curve that the maximum intensity in the above-described plane is found at sixty-five degrees both sides of zero (zero equals plane perpendicular to the sidewalk) or, in other words, twenty-five degrees out from the curb line toward the street. By setting the maximum intensity at this point, the strongest rays are thrown past such obstructions on the curb line as trees, poles, posts, etc., and by throwing the light rays ten degrees below the horizontal the rays are spread out

FIG. 4.—SKETCH OF REFLECTOR AND STANDARD.

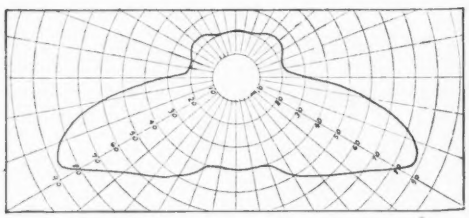


FIG. 2.—PHOTOMETRIC CURVE OF HORIZONTAL DISTRIBUTION.

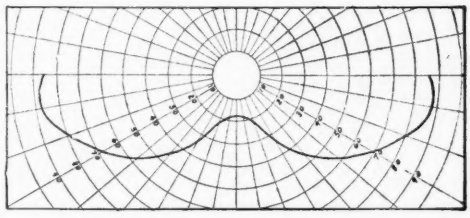


FIG. 3.—PHOTOMETRIC CURVE OF VERTICAL DISTRIBUTION.

in such a manner that they uniformly illuminate the street proper. The comparatively small amount of light thrown toward the sidewalk is ample to illuminate it so that it permits of easy vision without undue brilliance. The annoyance to householders of having a brilliant light source in front of their house is entirely overcome. The widespread use of eye-shades on lamp-posts is evidence that a reflector of this feature would be a welcome improvement.

Fig. 3 represents the intensity observed through a sixty-five-degree vertical plane (twenty-five degrees from the curb line toward street), or a vertical plane through the maximum-intensity point shown in Fig. 2, and indicates with what success the even distribution of light is accomplished.

A suggestion for the upper part of a fixture (pole or post) on which this reflector may be used is shown in Fig. 4, while Fig. 5 is the cross-section or detail drawing of the reflector, holder, socket, insulating joint, etc. It will be noticed that this reflector will, to a large measure, correct the general faulty appearance of the incandescent lamp when used with the ordinary type of flat reflector on a post, inasmuch as in the latter case the small lamp appears to be altogether out of proportion in comparison with the post which supports it, and therefore destroys the symmetry or proportion of the unit as a whole. The unit as suggested by Fig. 4 gives an appearance of size which overcomes this awkwardness.

manner; in other words, placed at forty-five-foot centres on either side of the street. The object of this diagram is to illustrate the point that the maximum rays of light are thrown past the trees. This illustration is not meant to convey an idea of the quantity of light but rather the direction of light rays, for in actual practice we would not see the distinct outline of light as noted in the illustration, but would observe practically a uniform illumination on the street owing to the redirecting qualities of the reflector. This reflector has the following dimensions: five and three-quarters inches wide, six and five-eighths inches high, three and one-quarter neck (holder).

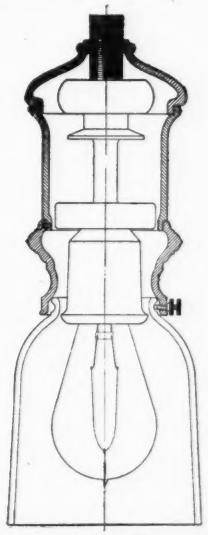


FIG. 5.—SECTION OF REFLECTOR AND HOUSING.

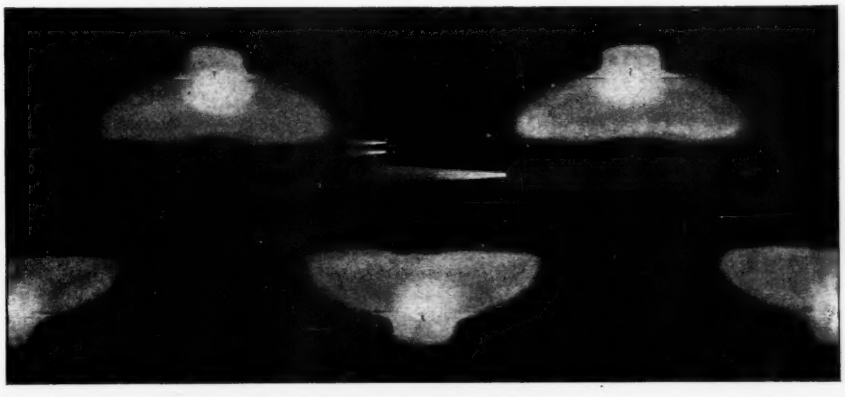


FIG. 6.—PICTORIAL REPRESENTATION OF DIRECTION OF LIGHT WITH HOLOPHANE STREET-LIGHTING REFLECTOR.

In Fig. 6 is shown a bird's-eye view of a series of these new units as used on a prominent street in a large city in the eastern part of this country. In this illustration, which is drawn to scale, the posts, on which are used the No. 243 reflectors and forty-candle-power street series tungsten lamps, are placed every ninety feet on both sides of the street in a staggered

Reflectors of this type are being made for incandescent gas mantles as well as incandescent electric lamps. Exhaustive tests are now being undertaken to secure as much data of the reflectors in actual use as can be secured to supplement the laboratory tests here recorded. These data will shortly be available.

Too much can not be said in favor of these new principles, as they are, in every sense, a distinct departure in street-lighting units and should go far toward revolutionizing our present methods in street lighting.

To Protect Westinghouse Company.

To protect the interests of the Westinghouse Electric and Manufacturing Company, Judge James S. Young, in the United States Circuit Court, at Pittsburg, Pa., on March 11, made an order allowing the receivers to pay $150,000 to the Mercantile Trust Company, of New York, and to receive coupons of bonds deposited as collateral. The petition upon which the order was made recites that last year 6,000 promissory notes for $1,000 each were made to the Mercantile Trust Company, and for this sum there was deposited as collateral $6,000,000 in five per cent first-mortgage bonds of the Lackawanna & Wyoming Valley Rapid Transit Company. The agreement also called for additional collateral in case of the depreciation of the value of the stock. The transit company, it is alleged, was unable to meet the interest due on bonds on February 1, and the trust company refused to turn the coupons over to the Westinghouse company, purposing to collect from the transit company. Nearly all of the bonds of the transit company are owned by the Westinghouse company, and plans have been made for the leasing of the road. According to the order of Judge Young, the receivers are to receive $100,000 treasury bonds of the Lackawanna company as security for the interest payment.

Receiver for Ohio Traction Company.

On the application of the Worcester Trust Company, of Worcester, Mass., Judge Thompson, in the United States Circuit Court, at Cincinnati, Ohio, on March 12, appointed C. J. Ferneding receiver for the Dayton & Xenia Transit Company. The Worcester company is trustee for $300,000 bonds, on which there was a default for interest in the years 1906 and 1907. The bonds were issued in 1903 at five per cent, payable in seventeen years. The security for these bonds was a second mortgage on the road and its property. A prior and first mortgage for $500,000 five per cent bonds, issued in 1901, is held by the Old Colony Trust Company, of Boston, and on these also interest remains unpaid.

Current Electrical News

DOMESTIC AND EXPORT.

WORK STARTED ON MEXICAN ELECTRIC LINE—The contract for the construction of the electric car line in the city of Chihuahua, Mexico, has been signed by Martin Falomir, director of the Light and Tramway Company, and Carlos F. Malau, the constructor. The material for the construction is on the ground and a force of engineers has been organized. It is believed that the work will be completed within six months.

POWER COMPANY WINS CASE—The Supreme Court has handed down a decision enjoining the Kalama Driving Company from interfering with or placing a dam in the Kalama River, Washington, above the power plant of the Kalama Electric Light and Power Company. The action was brought by the power company against the driving company to restrain it from building a dam above the plant of the company on the Kalama River, which restraining order was granted in the Superior Court and from which decree this appeal was taken.

BUTTE ELECTRIC AND POWER COMPANY—Stockholders of the Butte Electric and Power Company will hold a special meeting March 30, at Newark, N. J., to vote upon the issue of $5,000,000 thirty-year six-per-cent bonds, secured by a second mortgage upon the properties of the Butte Electric and Power Company and its subsidiaries, the Madison River Power Company and the Montana Power Transmission Company. The purpose of the issue will be to liquidate the floating debt of the companies and to provide them with additional working capital.

NEW KANSAS ELECTRIC ROAD—The state charter board of Kansas granted a charter to a ten-million-dollar company which is projecting an electric railway between Kansas City, Topeka and Independence. The charter fee, which was $5,077.50, was paid by E. M. Lambkin, of Kansas City, Mo., who is engineering the deal. It is said that the Kansas City & Kansas Southern, the name of the proposed new line, is an outgrowth of the Stranger Valley project. The Stranger Valley was capitalized at only $10,000 and was never looked upon seriously. However, the line was surveyed between Topeka and Kansas City and the new company falls heir to the survey. The survey follows the north bank of the Kaw River from Kansas City to Lawrence, then crosses and follows the Santa Fé into Topeka. The project is said to be backed by European capital, but the directors named in the application papers are all of this country. They are: J. E. Martin, Minneapolis; W. L. Moyer, New York city; W. Laming, Tonganoxie; E. M. Lambkin, Kansas City, Mo.; S. W. Brewster, Chanute; Harry E. Hopper, Indianola, Kan., and C. S. Dudley, Minneapolis, Minn. Mr. Lambkin states that the money for construction purposes is available and that work will begin in a few months. The company will take over all previous propositions for constructing a Kansas City-Topeka electric line and consolidate them.

PLAN TO REORGANIZE TRACTION COMPANY—A reorganization agreement for the Indianapolis & Cincinnati Traction Company is being sent out to the stockholders and bondholders of the company for their signatures. The agreement provides that each subscriber to the agreement will, on or before April 30, transfer to five trustees named in the agreement his stocks and bonds, to be controlled or disposed of by the trustees in accordance with the various clauses of the agreement. If the owners of all the capital stock and all of the bonds outstanding against the company transfer their stock and bonds in this manner to the trustees, the trustees will have the receivership of the company closed up, the indebtedness of the company paid and raise money for the extension of the road from Connersville to Hamilton, Ohio. To raise money for these purposes the trustees would be empowered to sell all or part of the bonds turned over to them. The agreement further provides that in the event all of the owners of the capital stock and bonds of the company do not turn over their stock and bonds to the trustees, the trustees are authorized to take such steps as they may deem proper to close out the receivership of the company by a sale of property at a judicial sale and to become the purchasers on behalf of the subscribers to the agreement, provided the property does not bring a price deemed greater than it would be wise to pay and then to organize a new company. The agreement, which was approved at a recent meeting of the stockholders and bondholders, at which more than three-fourths of the capital stock and bonds of the company was represented, has various provisions to protect the interests of the subscribers to it. The trustees named in the agreement are Theodore F. Rose and George A. Ball, of Muncie; Winfield T. Durbin, of Anderson; John J Appel, of Indianapolis, and Claude Cambern, of Rushville.

NEW INCORPORATIONS.

PEORIA, ILL.—Union Independent Telephone Company. $200,000.

LANSING, MICH.—St. Mary's Telephone Company, Sault Ste. Marie. $15,000.

MADISON, WIS.—Corning Telephone Company, Corning. $3,000. Incorporators: Julius Weckwerth and others.

AUGUSTA, ME.—Eastern Electrical Engineering Company. $100,000. President, D. F. Snow, Bangor; treasurer, W. E. Billings, Milford, N. H.

NASHVILLE, TENN.—Northwestern Dixie Telephone Company, Henry County; $1,000. Trezevant Telephone Company, Carroll County; $10,000.

MILWAUKEE, WIS.—The Hillsboro Light and Power Company, Hillsboro, Vernon County. $10,000. Incorporators: Rollin F. Myers, Gus Kolb and O. J. Kauffman.

AUGUSTA, ME.—Consolidated Power and Light Company of South Dakota, Portland. $3,000,000. President, G. A. Hutchins; treasurer, C. H. Tolman, Portland.

AUSTIN, TEX.—Citizens' Light and Power Company, of Taylor. $10,000. Incorporators: Howard Bland, E. A. Robertson, T. W. Marse, H. D. Mendell and C. B. Challener.

TRENTON, N. J.—The United Railway Company, Jersey City. To operate steam and electric railways. $200,000. Incorporators: J. R. Turner, H. O. Coughlin, L. H. Gunther, of Jersey City.

JERSEY CITY, N. J.—The Interstate Traction Company, Jersey City. To operate steam and electric railways. $200,000. Incorporators: G. R. Warner, B. S. Mantz and A. C. Baer, Jersey City.

TRENTON, N. J.—Mutual Benefit Electric Light and Power Company, Jersey City. $2,500,000. Incorporators: J. R. Blinck, R. S. Carrick, J. F. Nagle, Jersey City; J. M. Seymour, Jr., Newark.

TAYLORVILLE, ILL.—Taylorville Railway, Light, Heat and Power Company. To operate electric light, power and street railway plant. $5,000. Incorporators: J. A. Adams, Alice M. Moore and L. J. Perkins.

OBITUARY NOTE.

MR. JOHN BURRY, electrical engineer of the Stock Quotation Telegraph Company, and inventor of the Burry printing telegraph system, used by that company, died suddenly on the morning of March 11 at his home in Staten Island, N. Y. Mr. Burry was born at Fribourg, Switzerland, forty-seven years ago. He came to the United States when he was nineteen years old, and devoted himself to electrical study and work. His specialty became printing telegraphy, in which line, at his death, he was esteemed one of the greatest experts. He installed the printing telegraph plants in Rio de Janeiro and Buenos Aires about twenty years ago. In 1892 he associated himself with the Stock Quotation Telegraph Company.

PERSONAL MENTION.

MR. ELIJAH B. NICHOLS, for a number of years superintendent of the municipal electric light plant at Danvers, Mass., has resigned.

MR. THOMAS B. PECK, JR., has resigned his position as sales manager of the Electro-Dynamic Company, of Bayonne, N. J., and contemplates a southern trip, where he will rest and regain his health.

MR. C. W. KOINER, manager of the Los Angeles (Cal.) Gas and Electric Company, has been appointed superintendent of the municipal elèctric light plant at Pasadena, Cal., succeeding Charles C. Glass.

MR. E. W. HENDERSHOT, of Montreal, Canada, has been appointed controller of the Illinois Traction system. Mr. Hendershot will represent large Canadian interests in the company, the office of controller having been created for him.

MR. F. F. BARBOUR has been appointed secretary to President B. S. Josselyn, of the Portland (Ore.) Railway, Light and Power Company. This is a new office just created to relieve Mr. Josselyn of certain details. Mr. Barbour has been connected with the General Electric Company at San Francisco. R. M. Shepherd has been auditor of the company.

MR. GEORGE R. WEBB, of Baltimore, Md., has been made president of the Duquesne Lighting Company, Pittsburg, Pa., succeeding Robert C. Hall, who declined re-election. President Webb was formerly president of the Maryland Telephone Company, and also organized and financed the Baltimore Electric Company, which built up a large electric light and power business in that city. He is now interested in a central lighting plant at Wilmington, Del. Mr. Webb built the Pittsburg & Allegheny telephone system, and retains a large interest in that property. He will be in charge of active operations of the Duquesne company, and will spend most of his time in Pittsburg.

NEW MANUFACTURING COMPANIES.

NEW BEDFORD, MASS.—The Eastern Electric Company has been incorporated with a capital of $15,000 to deal in electrical appliances. The officers are: President and treasurer, E. H. Jennings, New Bedford; clerk, Thomas A. Loftus, New Bedford.

LONG BRANCH, N. J.—The Fred A. Kinsman Company has been incorporated to do a mechanical and electrical engineering business and to deal in electrical supplies. The incorporators are: H. C. Newton, E. E. Nuchens, F. A. Kinsman, Long Branch.

ELECTRICAL SECURITIES.

For the full week there has been an undertone of improvement and greater activity in the stock market, and prices have advanced in a fashion not seen in a year. Starting from such technical promptings as a "sold-out" market, a great show of strength has been realized. While the improvement in business is not so great that it has made any remarkable impression, that such improvement is on is unquestionably true. From out of the West comes news of more extensive movements of grain, and the American Railway Association estimates show a constantly decreasing number of idle cars. Last week the Baldwin Locomotive Company increased its work so that at least two-thirds of its large force are now busy. A greater tonnage is reported in the iron and steel trade, and preparations are being made for the reopening of several plants.

Dividends have been declared upon the following electrical securities: St. Joseph Railway, Light and Power Company; regular quarterly dividend of 1¼ per cent upon the preferred stock, payable April 1 to stock of record March 16. Winnipeg Electric Railway Company; quarterly dividend of 2½ per cent, increasing the dividend rate from 8 to 10 per cent per annum. Cincinnati Gas and Electric Company; regular quarterly dividend of 1⅛ per cent, payable April 1 to stock of record March 14. Union Traction Company of Indiana; regular semi-annual dividend of 2½ per cent on the preferred stock, payable April 1 as registered March 26. Canadian General Electric Company; quarterly dividend of 1¾ per cent on the common stock, a reduction, the dividend heretofore having been 2½ per cent quarterly; also, a semi-annual dividend of 3½ per cent on the preferred stock, both dividends payable April 1. Providence Telephone Company; regular quarterly dividend of $1 per share, payable April 1 to stock of record March 20. Cumberland Telephone and Telegraph Company; regular quarterly dividend of 1¾ per cent, payable April 1 to stock of record March 20. Michigan Light Company; quarterly dividend of 1 per cent on the common and 1½ per cent on the preferred stocks, payable April 1 to stockholders of record March 16. Seattle Electric Company; regular semi-annual dividend of 3 per cent on the preferred stock, payable April 1 to stockholders of record March 12. Duluth Edison Electric Company; regular quarterly dividend of 1½ per cent on the preferred stock, payable April 1 to stockholders of record March 17.

ELECTRICAL SECURITIES FOR THE WEEK ENDED MARCH 14.

New York:	*Closing.*
Allis-Chalmers common	6⅜
Allis-Chalmers preferred	17¼
Brooklyn Rapid Transit	44⅛
Consolidated Gas	100½
General Electric	120½
Interborough-Metropolitan common	7½
Interborough-Metropolitan preferred	19¾
Kings County Electric	90
Mackay Companies (Postal Telegraph and Cables) common	56¾
Mackay Companies (Postal Telegraph and Cables) preferred	61½
Manhattan Elevated	120
Metropolitan Street Railway	16
New York & New Jersey Telephone	99
Western Union	48
Westinghouse Manufacturing Company	40¾

The guaranteed quarterly dividend of 1¾ per cent on the capital stock of the Manhattan Railway Company will be paid on and after Wednesday, April 1, to stockholders of record at the closing of the transfer books on Friday, March 13. The transfer books will be reopened March 26.

Western Union directors have declared a dividend of 1¼ per cent, payable in stock. In the last quarter the company paid a stock dividend of 1¼ per cent. Stock certificates for the Western Union dividend, which is payable out of the $1,413,000 unissued stock, will be issued on April 15 to stockholders of record March 20. It is provided that fractional shares shall be issued in special certificates bearing no dividends, but convertible into full shares on the transfer of sufficient fractions. Books closed March 20 and will reopen April 1.

Boston:	*Closing.*
American Telephone and Telegraph	109½
Edison Electric Illuminating	200
Massachusetts Electric	46
New England Telephone	—
Western Telephone and Telegraph preferred	64½

Directors of the American Telephone and Telegraph Company have declared the regular quarterly dividend of 2 per cent, payable April 15 to stock of record March 19. On account of the annual meeting transfer books remain closed March 20 to March 31 inclusive.

Philadelphia:	*Closing.*
Electric Company of America	9
Electric Storage Battery common	27
Electric Storage Battery preferred	27
Philadelphia Electric	7½
Philadelphia Rapid Transit	16¼
United Gas Improvement	79

The Philadelphia Rapid Transit gross earnings for February showed an increase of more than $50,000 as compared with last year. The net earnings also showed a good increase.

Chicago.	*Closing.*
Chicago Telephone	110¼
Commonwealth Edison	90
Metropolitan Elevated preferred	50
National Carbon common	52⅛
National Carbon preferred	102½

The daily average of February traffic on the Chicago & Oak Park Elevated was 46,716 passengers, including transfers, a decrease of 2,357.

ELECTRIC LIGHTING.

WARTRACE, TENN.—A movement to establish an electric light plant here has been put on foot.

ASBURY PARK, N. J.—Harry J. Rockafeller has applied for a lighting franchise in Asbury Park.

LAFAYETTE, IND.—The city council has voted down the municipal electric light plant project.

MOORHEAD, MINN.—The municipal lighting plant shows a net income of $13,752.95 for the past year.

ATLANTIC CITY, N. J.—Contracts have been signed by the city for new lamp posts at a cost of $40,000.

HANNIBAL, MO.—C. W. Neeper, referee in bankruptcy, has ordered the sale of the Huntsville Light and Power Company.

TENNILLE, GA.—The electric light plant was totally destroyed by fire on March 3, involving a loss of $7,000, partly covered by insurance.

PORTLAND, ORE.—At a meeting of the city council the executive board was authorized to advertise for bids for the city lighting for a term of five years.

HUGHESTOWN, PA.—At a special meeting of the Hughestown borough council a ten-year contract was awarded the Citizens' Electric Illuminating Company, of Pittston.

SOUTH NORWALK, CT.—The city of South Norwalk has voted to furnish the East Norwalk fire district with electric current at the rate of five cents per kilowatt-hour.

BINGHAMTON, N. Y.—The Binghamton Light, Heat and Power Company has completed enlargements to its Court street station which will increase its capacity by 1,000 horse-power.

DANVILLE, ARK.—A. Pace has placed orders for the machinery needed for the electric light plant at Danville, a franchise for which has been granted him by the town council.

WHITE BLUFF, TENN.—A movement is on foot to put in an electric light plant and waterworks for White Bluff at an early date. Plans are being made and sentiment is strong in favor of the new enterprise.

SOUTH BEND, WASH.—A contract has been entered into with T. H. Ridgeway of the Electrical Engineering Company of Seattle whereby the Raymond Electric Company's line will be extended to South Bend.

NOBLESVILLE, IND.—The commissioners have granted the Noblesville Heat, Light and Power Company right of way to erect a line of poles on the road leading from this city to Cicero. The town is already wired.

HILLMAN, MICH.—Hillman will have an electric light and waterworks plant. David Watson, of Alpena, and L. C. Rouse, have been granted a forty-year franchise. It is expected to have the plant in operation by June 1.

CINCINNATI, OHIO—At the annual meeting of the Union Gas and Electric Company, M. E. Moch was elected a director to succeed H. A. Nordeck, and Olaf Ussing was elected in place of M. F. Plant. The other directors were re-elected.

OROVILLE, CAL.—The board of supervisors has sold a franchise for a pole line to convey electric power to the Great Western Power Company. The power line will only cross public roads, as it will be built on a private right of way.

CONCORD, N. H.—William H. Burgen and Howard W. Lang, of Boston, with their attorneys, are the incorporators of the Milford Light and Power Company, capital stock, $150,000, which has been incorporated under the general law of New Hampshire.

MORETOWN, VT.—At a meeting of the voters of Moretown it was decided to exempt from taxation for a period of ten years the proposed water plant of Moody & Almon on the Mad River in that town above their present plant. Work is to begin at once. It is expected to transmit 400 horse-power to Moretown.

CAMDEN, N. J.—The Camden city council has authorized a contract to be entered into with the Public Service Corporation for the lighting of the streets at $80 per year per light. The contract is to date from January 1, 1908, and is to extend six years. Heretofore the city has paid $109.50 per year per light.

TROY, N. Y.—At the annual meeting of the Hoosick River Electric Light and Power Company, George E. Greene, of Hoosick Falls; H. R. Leyden, of this city, and Howard W. Stann, James O. Carr and George C. Hollister, of Schenectady, were elected directors. They chose the following officers: President, Mr. Greene; vice-president, Mr. Stann; secretary and treasurer, Mr. Leyden.

OAKLAND, CAL.—At a meeting of the city council a resolution was introduced looking to the acquirement of a municipally owned plant. The resolution, which was adopted, provided that a committee of three councilmen be appointed to confer with a like committee from the Berkeley board of town trustees looking to the establishment of a municipal lighting plant for the two cities.

CLYDE, N. Y.—Syracuse parties representing the Fort Wayne Electric Company have dismantled the old gas and electric light plants of the former Clyde Gas and Electric Company. The local plant was built in 1890 and furnished light to the village until about five years ago, when the village took the contract away from the local company and gave it to the Wayne County Electric Company, of Lyons.

PHILADELPHIA, PA.—The lease of its light plant from the borough of McAdoo, Schuylkill County, to the Harwood Electric Light Company has been filed. The lease covers a period of twenty-five years from February 1, 1908, and the company in return agrees to pay off in that period a bonded indebtedness of $20,000 and interest thereon at five per cent. The borough was steadily losing money on the plant.

BOSTON, MASS.—An order has been issued from the gas and electric light commission authorizing the Lynn Gas and Electric Company to make an additional issue of 1950 shares of the par value of $100 a share, of which 950 shares shall be used for the payment of promissory notes and 1,000 shares for the extension of the plant. The gas and electric light company fix the market value of such shares at $235 a share.

FORT WORTH, TEX.—The light and power company has applied for a franchise from the North Fort Worth city council. It is understood that a sufficient number of subscribers have been secured to guarantee the success of the new plant. The company will consist of J. H. Poulter, of Rosen Heights, and Illinois parties. The company proposes to furnish current at twelve and one-half cents per kilowatt-hour with a $2.50 minimum for residences.

FAYETTEVILLE, N. C.—The Cape Fear Power Company, located near Fayetteville, has turned on the current at the Holt-Morgan Cotton Mills as the first of a series of mills to be run by hydro-electric power in the vicinity of Fayetteville. The Southern Power Company, whose plant is located on the Catawba, has received a franchise to enter Salisbury, which is another manufacturing centre where electrical power will be extensively applied.

ATLANTA, GA.—Although the appropriation in the January apportionment sheet of the council finance committee for electric lights amounted to but $85,000 as compared to $92,000 for the preceding year, about as many new electric lights will be installed this year as were put in service in 1907. Councilman Pomeroy, chairman of the committee on electric lights, telephones and telegraphs, estimates that thirty additional street arc lights and fifty additional street incandescents can be installed. The contract made with the Georgia Railway and Electric Company last year goes into effect on April 1. The new contract calls for arc lights at $60, as compared to $75 under the old contract, and incandescents for $30, as compared to $37.50.

COLORADO SPRINGS, COL.—The Pikes Peak Hydroelectric Company, which has been granted a street-lighting contract, has placed an order with the General Electric Company for 300 new arc lights for street purposes, in accordance with the new contract recently made with the city. The new lights are 7.5 ampere enclosed lamps, and differ considerably in appearance from the lights in present use. The change in lamps necessitates a change of transformers in the substation, and the resulting outlay will cost the company in the neighborhood of $3,500. The Hydro company will hasten the installation of the new lights as much as possible and expects to have them in use about May 10, thirty days before the time limit set by the city council.

ELECTRIC RAILWAYS.

ALBANY, N. Y.—The New York & North Shore Traction Company has filed a certificate with the secretary of state announcing a number of extensions.

HUNTSVILLE, ALA.—The new duplicate plant of the Huntsville Railway, Light and Power Company, is now in operation, having recently been installed at a cost of $30,000.

PITTSFIELD, ILL.—The city council has granted a franchise to the St. Louis, Terre Haute & Quincy Traction Company, to operate electric cars on the streets of this city. A similar franchise has been granted in Taylorville.

DENVER, COL.—Work has been commenced on the new Globeville line of the Denver Tramway Company. This line will be used by the Colorado & Southern's Denver-Boulder electric interurban cars as well as by the tramway.

LINCOLN, ILL.—Steps have been taken to organize an interurban railroad company to build an electric line from Thayer, through Mt. Auburn and Illiopolis, to Mt. Pulaski. C. L. Gandy, of Mt. Auburn, presided over a recent meeting.

FOND DU LAC, WIS.—The annual stockholders' meeting of the Eastern Wisconsin Railway and Light Company, the Fond du Lac Street Railway and Light Company, and the Fond du Lac Gas Company resulted in the re-election of all the directors and officers.

MONTCLAIR, N. J.—Surveyors are at work mapping out a route for a new trolley line to be built by the Public Service Corporation from Upper Montclair to Paterson. At present communication between Montclair and Paterson is only possible by making a détour of many miles.

RENO, NEV.—The announcement is made that the Southern Pacific Company will soon install a plant for generating all of the electricity for power and light in its shops at Sparks. The plant will have a capacity of 540 horse-power and will involve an expenditure of over $30,000.

BARBOURVILLE, KY.—An electric railroad from this city to Manchester is being proposed by Lexington and Louisville men, who will take out a charter. A survey will be made immediately and the chances are excellent for the early beginning of work. The distance is twenty-four miles and offers an easy grade.

RENO, NEV.—James Sword, of Salt Lake City, is to erect a 150-ton custom mill at Schurz to handle the ore of that district In addition an electric railroad is to be built from Schurz to Rawhide. The power is to be developed on the Walker River, which passes within a short distance of Schurz. This power is also to be used in operating the mill. Work is to begin within ninety days.

PORT HURON, MICH.—A continuous line of the third-rail system, connecting this city with Lansing, is the plan of the Michigan United Railways Company. The company will begin work early this spring taking out many curves in the track between Kalamazoo and Battle Creek and that part of the road which is on the highway will be put on private right of way. Battle Creek and Lansing will have direct connection.

MILWAUKEE, WIS.—The articles of incorporation of the Milwaukee & Fox River Valley Railway Company have been amended so as to enable the company to build to Milwaukee. The line will run in a northeasterly direction through the counties of Milwaukee, Washington, Ozaukee, Sheboygan, Manitowoc, Calumet, Winnebago and Outagamie to the city of Appleton, and also from Fond du Lac through Fond du Lac and Calumet counties.

COLUMBUS, OHIO—Notices of a special meeting of the stockholders of the Columbus, Delaware & Marion Railway Company are being mailed by the board of directors, the meeting to be held in the Chittenden Hotel March 27. The purpose of the meeting is to take action on a proposed increase of capital stock of the company, the amount of increase to be determined upon by the stockholders. The present capitalization of the company is $2,500,000, and this amount will likely be increased to $3,000,000.

WASHINGTON, D. C.—The bill proposing to authorize and direct the Baltimore & Washington Transit Company to extend its lines in the District of Columbia has been passed by the Senate. The usual requirements as to roadbed, paving and electrical equipment are contained in the bill, and the company is required to deposit $1,000 with the district commissioners within sixty days of the approval of the bill as a guarantee that the requirements thereof will be met. The new line is to be completed within two years from the approval of the act.

FORT WORTH, TEX.—Stockholders of the Northern Texas Traction Company have elected the following board of directors: John W. Hallowell, W. B. Harrison, Benjamin Joy, A. Homer Hathaway, Henry Hayes, E. Howard George, Guy E. Tripp, Alvah K. Todd and John W. Oakes. The officers are: Guy E. Tripp, president; John T. Hallowell, first vice-president; H. T. Edgar, second vice-president; Henry R. Sawyer, treasurer; Willard W. Dow, assistant treasurer; Arthur W. Q. Birtwell, assistant treasurer; Alvah K. Todd, secretary, and Charles E. Aldrich, Jr., assistant secretary.

LANCASTER, PA.—It is expected work will be started on the Elizabeth & Florin Street Railway line about April 1, when the frost is out of the ground. The line is capitalized at $220,000 and almost the entire issue has been subscribed. Most of the right of way has been obtained. The terminus of the line will be at the west end of Elizabethtown. Eventually the road will be extended to Middletown, giving through connection to Harrisburg. The Elizabethtown & Florin road, which is really an extension of the Mount Joy line, will be leased upon its completion in the fall by the Conestoga Traction Company at an annual rental equal to six per cent on the capital stock.

ASHLAND, WIS.—An important step in the development of the water power adjacent to Ashland has been taken, the state railway commission having granted to the newly organized Ashland Power Company, organized by A. E. Appleyard and others at Eau Claire, the right to sell $50,000 common stock and $50,000 preferred stock, and to issue $300,000 bonds to be used for the purpose of buying and developing the properties of the Ashland Light, Power and Street Railway Company and extending its lines. An interurban line will be run from Ashland past the plant of the Atlantic Dynamite Company to Washburn, and power will be brought here from Copper Falls. Within the past two months power has been brought into the city from White River, where a power plant has been developed during the past summer at a cost considerably over $100,000.

NEW BRITAIN, CT.—The Connecticut Company has negotiated an agreement with the Hartford Electric Light Company to supply electricity for traction, light and power purposes in the New Britain district. The power which for several years has been used for trolley and lighting purposes in New Britain, Southington, Plainville and Berlin has been transmitted from the plant which the New Milford Power Company operates at Bull's Bridge on the Housatonic River in Litchfield County. The result has not been satisfactory. Last summer much embarrassment was caused by inadequate power due to the low water in the Housatonic. The liability to breakdowns due to the exposed position of the cables is great. Power from the Bull's Bridge plant will continue to be used in the Waterbury district, which is much nearer the generating station than is New Britain.

DATES AHEAD.

Iowa Electrical Association. Annual meeting, Des Moines, Iowa, April 22-23.

Iowa Street and Interurban Railway Association. Annual meeting, Des Moines, Iowa, April 23-24.

American Electrochemical Society. Next meeting, Albany, N. Y., April 30-May 2.

Nebraska Electrical Trades Association. First annual electrical show, Auditorium, Omaha, Neb., May 4-9.

Nebraska Electrical Association. First annual meeting, Omaha, Neb., May 6-7.

West Virginia Independent Telephone Association. Annual meeting, Fairmont, W. Va., May 7-9.

Southwestern Electrical and Gas Association. Annual convention, El Paso, Tex., May 7-9.

Railway Signal Association. Next meeting, New York city, May 12.

Ohio Society of Mechanical, Electrical and Steam Engineers. Next meeting, Columbus, Ohio, May 15-16.

National Electric Light Association. Annual meeting, Chicago, Ill., May 19-22.

Telephone Association of Texas and Louisiana. Annual meeting, Dallas, Tex., May 25-27.

American Institute of Electrical Engineers. Annual meeting, Atlantic City, N. J., June 29-July 2.

National Electrical Contractors' Association. Next meeting, Chicago, Ill., July 15.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October.

TELEPHONE AND TELEGRAPH.

CHARLOTTE, N. Y.—The Bell Telephone Company has installed a new switchboard in its Charlotte exchange.

PINE BLUFF, ARK.—The Pine Bluff Telephone Company has completed its line from Redfield to Pine Bluff. This is a metallic circuit.

PORTSMOUTH, VA.—The Southern Bell Telephone and Telegraph Company has purchased a site on which it will shortly erect an exchange building at a cost of $100,000.

SAVANNAH, GA.—The sale of the Georgia Telephone Company to the Southern Bell Company has been consummated. The merger of the two concerns will be accomplished as speedily as possible, though it will probably be some weeks before all the system is operated by the Bell company.

PLATTSMOUTH, NEB.—J. A. Collin, electrician for the Burlington, says that work will begin immediately on a metallic-circuit telephone line from Gilmore Junction to Oreapolis, to connect with the one running from that place to Pacific Junction. He will also connect Cedar Creek and Cullom, on the cutoff line.

CONCORD, N. H.—The directors of the White Mountain Telephone Company have elected the following officers: President, Allen Hollis, Concord; vice-president, D. B. Keniston, Plymouth; clerk, George H. Adams, Plymouth; executive committee, C. J. Ayer, Plymouth; F. W. Story, Laconia; J. M. Kellar, Boston.

SPOKANE, WASH.—Official announcement is made that the Pacific States company has 12,440 telephone instruments in operation in Spokane at this time, a gain of nine per cent over last year. As soon as the Home Telephone Company completes its plant in April this number will be increased to 20,000.

MORRISVILLE, N. Y.—The lines and business of the Earlville Telephone Company, whose lines traverse nearly all the country roads in southern Madison and northern Chenango counties, have been sold to Charles Chandler, of Brookfield, and Jerry D. Holey, of Earlville. The company at present has over 700 telephones in operation. The consideration is understood to have been a little over $20,000.

WINFRED, S. D.—A stock company, composed of six of the leading business men of this place, has been formed for the purpose of installing and operating a local telephone system. The company will be incorporated under the name of the Winfred Telephone Company and will have sufficient capital to install the system and provide a working fund. At a meeting of the stockholders of the company the following officers were elected: President, G. M. Simmons; vice-president, J. F. Barthell; secretary-treasurer, Myrt Chapin; trustees, W. Beddow, J. A. Leighty and J. A. Karrer.

TREMONT, ILL.—A deal has been completed by which the Union Independent Telephone Company, of Augusta, Me., purchased the Tazewell County Telephone Company for $38,400. Possession is given at once. This concern had previously purchased the Tremont Independent Telephone Company, and it is understood that the purchaser will consolidate the two exchanges and improve and extend the system. The Tazewell County Telephone Company was organized eight years ago and had over 1,700 telephones in use. It maintained exchanges at Tremont, Morton and Groveland and had lines to Hopedale, Washington, Farmdale, East Peoria, Pekin and Deer Creek. H. L. Schmutz was president; George Bird, secretary and treasurer; William Moschel, Morton, general manager.

NEW PUBLICATIONS.

"WHAT FORESTRY HAS DONE"—A circular entitled "What Forestry Has Done" has been published by the Forest Service, and is obtainable upon application to the Forester, Washington, D. C. This reviews the forest work that foreign countries are doing. The United States is enormously behind in its expenditures for the management of the national forests. Nevertheless, returns have already increased with increased expenditure for management. The reports from other countries show that forestry pays, and that it pays best where the most money is expended. A second lesson clearly brought home by foreign forestry is the need of timely action, since forest waste can be repaired only at great cost.

THE CHIEF CAUSE OF THE FAILURE OF MUNICIPAL TELEPHONY IN GREAT BRITAIN—A very interesting article, entitled "The Chief Cause of the Failure of Municipal Telephony in Great Britain," by Victor M. Berthold, of Needham, Mass., has been reprinted from the *Quarterly Journal of Economics*, vol. xxii, February, 1908. This article discusses the various phases of the organization and development of municipal telephone service in Great Britain. The author criticizes the policy of the British Post-Office, and maintains that, contrary to otherwise expressed opinion, the failure was due primarily to technical mistakes in the planning of the system, and to financial mistakes in the working out of the organization and in the fiduciary plans.

INDUSTRIAL ITEMS.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., has ready for distribution its bulletins descriptive of Fort Wayne electric fan motors for 1908, and Form B multiphase belted alternators.

THE AMERICAN TRANSFORMER COMPANY, Newark, N. J., announces that it has secured the services of A. Press, formerly connected with the Siemens & Halske interests, who will act as its chief electrical engineer.

THE F. BISSELL COMPANY, Toledo, Ohio, has issued the first of a series of calendar cards which will be sent each month to its patrons. The company will be pleased to forward this calendar regularly to those interested, upon request.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., has published bulletin No. 5910-2, devoted to a description and illustrations of power equipment for boot and shoe factories. Copies of this bulletin may be had upon request to the company.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., in bulletin No. 52 describes a number of important applications of Paiste National Electrical Code taplets. There is also considerable space given to descriptions and listings of "Security" snap sockets.

THE RIDGWAY DYNAMO AND ENGINE COMPANY, Ridgway, Pa., announces the opening of a district sales office at 907 Andrews Building, Cincinnati, Ohio. George W. Euker, who has had a varied experience in electrical and power plant work, is in charge as manager.

THE WHEELER CONDENSER AND ENGINEERING COMPANY announces the removal of its general offices to its factory at Cartaret, N. J. The telephone number is 141 Rahway. A New York office will be maintained at 90 West street, telephone number 4931 Cortland.

DOSSERT & COMPANY, New York city, announce that F. A. Lawson & Company, San Francisco, Cal., have become their Pacific Coast agents. This company has already placed large orders for Dossert joints and solderless cable connectors and terminals. It is located at 209 Monadnock Building, San Francisco.

THE UNION SWITCH AND SIGNAL COMPANY, Swissvale, Pa., has issued three important catalogues. One is devoted to alternating-current block-signaling apparatus, another to electric crossing bells, and the third to alternating-current Union style "B" electric automatic block signals on the New York, New Haven & Hartford Railroad.

THE FIBRE CONDUIT COMPANY, Orangeburg, N. Y., is distributing a series of folders devoted to its products. The current issue takes up a report of tests of fibre conduit made by the Electrical Testing Laboratories. This report shows many remarkable qualities, and is worthy of careful study by all those interested in this department of engineering.

THE RAILWAY SPECIALTY AND SUPPLY COMPANY, Chicago, Ill., has published bulletin S-128, describing and illustrating the "Ideal" ground plate. This bulletin emphasizes the importance of ample and efficient ground connection for the proper protection of signal apparatus. The eastern agent of the company is the Universal Railway Supply Company, Baltimore, Md

J. N. KELMAN, 1,000 North Main street, Los Angeles, Cal., has issued an attractive folder describing the Kelman high-voltage "short-circuit" breakers. These breakers open a short-circuited line the instant a short is formed, without affecting the rest of the system. The operator can immediately test the line by closing the breaker. If the short-circuit is still on, the instant contact is made the action of the trip coils disconnects the handle, and the

breaker opens without affecting the rest of the system. Descriptive matter and full information will be furnished upon request to the company.

THE LORD ELECTRIC COMPANY, New York city, has published bulletin G, devoted to Earll trolley catchers. This is the first description that has ever been published of this device, although it has been sufficiently long in service to prove its valuable qualities. A number of substantial orders have been taken as a result of recent severe tests. The Earll trolley catchers are interchangeable with the Earll trolley retrievers.

THE WESTINGHOUSE TRACTION BRAKE COMPANY, Pittsburg, Pa., devotes special publication No. 9,009 to "Magnetic Brakes," which is a reprint of a paper presented by A. L. C. Fell before the Tramways and Light Railways Association, of London, England, on January 10, 1906. At the time this paper was first presented it attracted a great deal of attention and provoked considerable discussion both here and abroad. Mr. Fell has made a number of very valuable tests, and his conclusions are of great interest and value. The company will be pleased to send copies of this report to those interested, upon request.

THE WESTINGHOUSE MACHINE COMPANY, East Pittsburg, Pa., reports for the first two months of this year a good demand for Roney mechanical stoker equipments. The most interesting orders have come from cold-storage companies. The Merchants' Ice and Cold Storage Company, of Cincinnati, Ohio, is installing three equipments. The Montgomery Ice and Cold Storage Company, of Jenkintown, Pa., is installing two equipments, and the Holt Ice and Cold Storage Company, of Indianapolis, Ind., the same number. The municipal lighting station at Troy, Ohio, operated by the Board of Public Service, has adopted Roney stokers, and the Pennsylvania Light, Heat and Power Company, of Allegheny, Pa., operating a large central station at that place, is increasing its present equipment with two stokers of large capacity. The Mutual Union Brewing Company, of Aliquippa, Pa., is installing three equipments, and the Alpha Portland Cement Company, operating a number of plants throughout the country, is installing one of the largest-sized stokers.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., in bulletin No. 4,566, describes some new types of tantalum lamps. The lamps are rated for forty, fifty and eighty watts, the forty and fifty-watt types replacing the former forty-four-watt lamp. The fifty-watt lamp will enable stations to maintain their output per lamp the same as with the present sixteen-candle-power lamp, and give the customer fifty per cent increase in candle-power. An interesting table is given, showing the saving secured for 750 hours of service at various loads per kilowatt-hour. This indicates that with the average cost of current to the consumer in force, the tantalum lamp saves more than twice its cost. Other very interesting data are given, which make this bulletin of great value to the central station man or lamp user. Bulletin No. 4,571 is devoted to the tungsten lamp in street lighting. This lamp consumes approximately one-third the energy required by the carbon-filament lamp for the same candle-power. The present bulletin describes the types of lamps suitable for street-lighting service, and gives data and prices, candle-power distribution curves, and illustrations of the lamp and ornamental brackets used for this purpose.

Record of Electrical Patents.

Week of March 10.

881,108. APPARATUS FOR ELECTROLYSIS OF BRINE. Courtland F. Carrier, Jr., Elmira, N. Y., assignor to Elmira Electrochemical Company, Elmira, N. Y. Mercury is circulated through the decomposing compartment, its superficial area diminishing in the direction of flow.

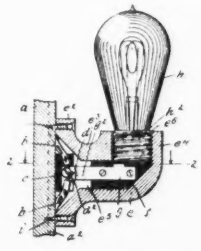
881,114. ELECTRIC VIBRATOR. John M. Dinkins, Indianapolis, Ind., assignor to the Hercules Electric and Manufacturing Company, Indianapolis, Ind. An electric bell.

881,115. ELECTRICALLY OPERATED FENDER FOR STREET RAILWAY CARS. Nathan Fallek, Denver, Col. The fender is lowered by an electrically released catch.

881,138. ELECTRIC BLOCK SIGNAL. Edward P. Matter, Alexandria, Va. A system employing both track and train signals.

881,181. BATTERY HOLDER. Emory S. Egge, Montgomery, Ala. A battery case with enclosed terminals.

881,247. ELECTRIC PUMP REGULATOR. Andrew Koesche, Chicago, Ill. A quick-break switch actuated by a weight and a spring.



881,284.—WALL BRACKET FOR ELECTRIC LIGHTS.

881,264. ELECTRIC SIGNAL DEVICE. Elias Schermerhorn, Amsterdam, N. Y., assignor of one-half to William P. McKeough, Amsterdam, N. Y. A combined battery and lamp controlled by a relay.

881,284. WALL BRACKET FOR ELECTRIC LIGHTS. William R. Atkinson, New York, N. Y. A bracket for molding work.

881,297. SOCKET FOR ELECTRIC LAMPS. Charles G. Burton, Peru, Ind. A key socket.

881,300. ELECTRIC SWITCH. Everett M. Coffin, Oakland, Cal. A rocking push switch.

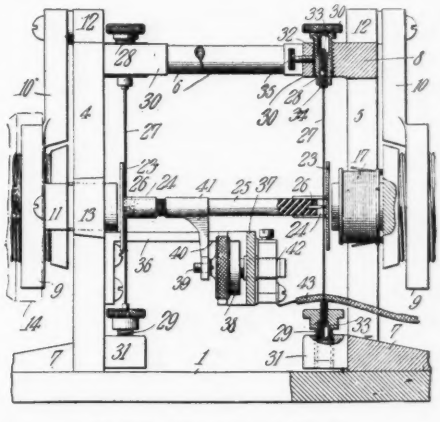
881,306. ELECTRIC SWITCH. George Cutter, South Bend, Ind. A switch for series circuits.

881,344. ELECTRICAL SIGN RECEPTACLE. Frank J. Russell, New York, N. Y. A receptacle clamped in the sign plate by the cap and base.

881,359. TROLLEY-POLE CONTROLLER. Cisco R. Traxler and Edward E. Lineback, Winston-Salem, N. C. A weight is attached to the trolley pole cord and runs in a vertical guide.

881,360. TELEPHONE RELAY. Charles W. Underwood, Crowley, La. A magnetic relay the armature of which is in operative relation with the magnet of the receiver.

881,371. ELECTRICAL PLUG AND RECEPTACLE. Pennell C. Brown, Boston, Mass., assignor of one-half to Frank J. Russell, New York, N. Y. A self-locking plug.



881,360.—TELEPHONE RELAY.

881,404. ELECTRIC ESCAPEMENT FOR TIME MOVEMENTS. Charles F. Hollister, Waterbury, Ct. The escapement lever is operated by an electromagnet.

881,456. DYNAMOELECTRIC MACHINE. Henry Berg, Orange, N. J. The armature is provided with vanes for producing ventilation.

881,470. TROLLEY. Charles Harkness, Providence, R. I., assignor, by mesne assignments, to the United Traction Improvement Company. A double-wheel trolley.

881,479. CHRONOGRAPH. Ezra B. Merriam, Schenectady, N. Y., assignor to General Electric Company. A device for recording the frequency of alternating currents.

881,503. AUTOMATIC STREET INDICATOR. Thomas Tighe and Charles S. Cross, New York, N. Y. An indicator automatically driven by an electric motor which is in electrical connection with the car motor.

881,518. ELECTRIC FURNACE. Charles E. Wilson, Ferris, W. Va. A furnace with a plurality of terminals, each supporting a number of removable electrodes.

881,519. ELECTRODE HOLDER FOR ELECTRIC SMELTING FURNACES. Charles E. Wilson, Ferris, W. Va. A holder for clamping furnace electrodes.

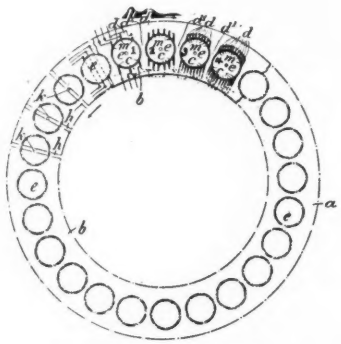
881,520. SECTIONAL ELECTRODE FOR ELECTRIC FURNACES. Charles E. Wilson, Ferris, W. Va. A form of electrode permitting two or more sections to be coupled together.

881,527. PROCESS FOR TREATING COMPLEX COBALT ORES AND FOR REFINING COBALT FROM NICKEL, ARSENICAL AND SILVER-BEARING ORES. Ernest E. Armstrong, Niagara Falls, N. Y. Cobalt is electrochemically precipitated as the oxide by electrolyzing it in the presence of a halogen salt.

881,539. ELECTRIC BELL. Donald M. Bliss, New York, N. Y. The striking magnet is actuated by a separate magnet and vibrator.

881,565. SAFETY-LIMIT SWITCH. Henry A. Everett, Barrington, N. J., and Arthur Parker, Philadelphia, Pa. A switch for limiting the motion for a train of gears.

881,580. METHOD OF RECOVERING COPPER FROM ORE OR MATTE BY ELECTROLYSIS. Henry K. Hess, Philadelphia, Pa. Porous briquets containing particles of comminuted ore are immersed in an electrolyte and subjected to the action of an electric current.



881,585.—ELECTRIC MOTOR.

881,585. ELECTRIC MOTOR. Edward Hopkinson and Julius Frith, Manchester, England, assignors to Mather & Platt, Limited, Manchester, England. A motor of the induction type having a plurality of rotors mounted to revolve about separate axes, with a common magnetic field.

881,587. TROLLEY-WHEEL-PLACING DEVICE. Hubert G. Husted, Oberlin, Ohio. A roller with a double helical groove.

881,588. METHOD OF EXHAUSTING VAPOR CONDUCTORS. Alexander M. Jackson, Schenectady, N. Y., assignor to General Electric Company. The lamp tube and the condensing chamber are both connected with the exhaust pump.

881,596. ELECTRIC CARRIER. Sam H. Libby, East Orange, N. J., assignor to Sprague Electric Company. A telpherage carriage.

881,597. PROJECTOR. Charles E. Lord, Cincinnati, Ohio, assignor to General Electric Company. A projector with adjustable reflecting surface.

881,599. MEANS FOR TRANSMITTING POWER FROM THE AXLES OF RAILWAY CARS. Lawrence C. Maher, Philadelphia, Pa. A friction drive provided with an electromagnet for separating the two wheels.

881,628. TELEPHONE CUTOUT. Edwin W. Smith, New York, N. Y. An electromagnet in the main line enables any one of a number of party lines to be connected to the former.

881,635. CAB SIGNAL SYSTEM. David P. Thomson, Schenectady, N. Y., assignor to General Electric Company. An alternating-signaling system acting through the track rails.

881,636. BALANCER SET. Louis E. Underwood and Richard W. Douglass, Lynn, Mass., assignors to General Electric Company. A motor-generator group connected across the system, means being provided for controlling the connections of the shunt fields.

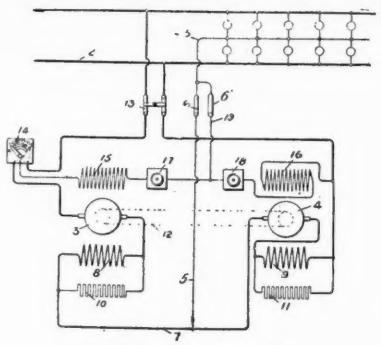
881,647. SELF-EXCITED ALTERNATOR. Ernest F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. The field winding is provided with a rectifying commutator, current being supplied from an auxiliary winding on the armature.

881,683. ELECTRICAL SOCKET SEAL. Llewellyn T. Hatfield, Sacramento, Cal. A seal inserted in a socket which prevents a plug, if inserted, from making electrical contact and makes it necessary to destroy the plug before it can be withdrawn.

881,686. ELECTRIC SWITCH. Silvester Hoadley, Gosport, Ind. A double-throw switch.

881,712. TELEPHONE RECEIVER. Hermann G. Pape, New York, N. Y. The magnet and diaphragm are housed within the receiver case.

881,743. DYNAMO SUSPENSION. William I. Thomson, Newark, N. J., assignor to the Safety Car Heating and Lighting Company. A suspension for a train-lighting dynamo.



881,636.—BALANCER SET.

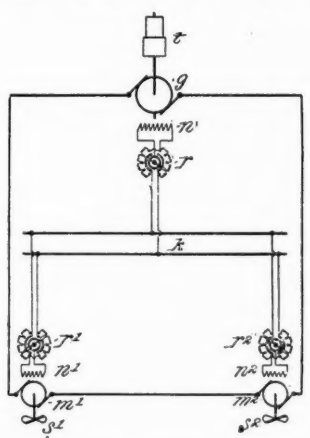
881,765. STARTING DEVICE FOR MERCURY-VAPOR ELECTRIC LAMPS. Louis A. Audibert, Lodève, France. An additional mercury chamber is provided for making contact with the lamp anode.

881,766. RAILWAY BLOCK SYSTEM. Oliver Barnish, Springfield, Mass., assignor of one-half to John M. Newell, Springfield, Mass. Electromagnetically controlled trips along the track operate signals on the train.

881,777. TERMINAL FOR ELECTRIC CABLES. Charles W. Davis, Edgeworth, Pa., assignor to Standard Underground Cable Company, Pittsburg, Pa. A head provided with insulating terminals.

881,810. ELECTROPLATING APPARATUS. George A. Lutz, New York, N. Y., assignor to American Circular Loom Company, Portland, Me. A cathode plate is provided for suspending the articles to be plated between two sets of anodes.

881,811. ELECTROPLATING APPARATUS. George A. Lutz, New York, N. Y., assignor to American Circular Loom Company, Portland, Me. A form of electric plating tank.



881,864.—MEANS FOR TRANSMITTING POWER ELECTRICALLY.

881,847. THERMOSTAT. Fred P. Butman, Holbrook, Mass. A thermostat for bearings.

881,864. MEANS FOR TRANSMITTING POWER ELECTRICALLY. Gregor Lewin, Schöneberg, near Berlin, Germany, assignor to Siemens-Schuckert-Werke, G. M. B. H., Berlin, Germany. The generator and motor armatures are connected in series, separate means being provided for controlling their field excitation.

881,878. TELEPHONE SWITCH. Andy N. Wright, Jackson Center, Ohio, assignor of one-third to Harney L. Hill, Jackson Center, Ohio. A plug switch.

881,880. GALVANOMETER. Sidney G. Brown, London, England. A galvanometer for alternating currents.